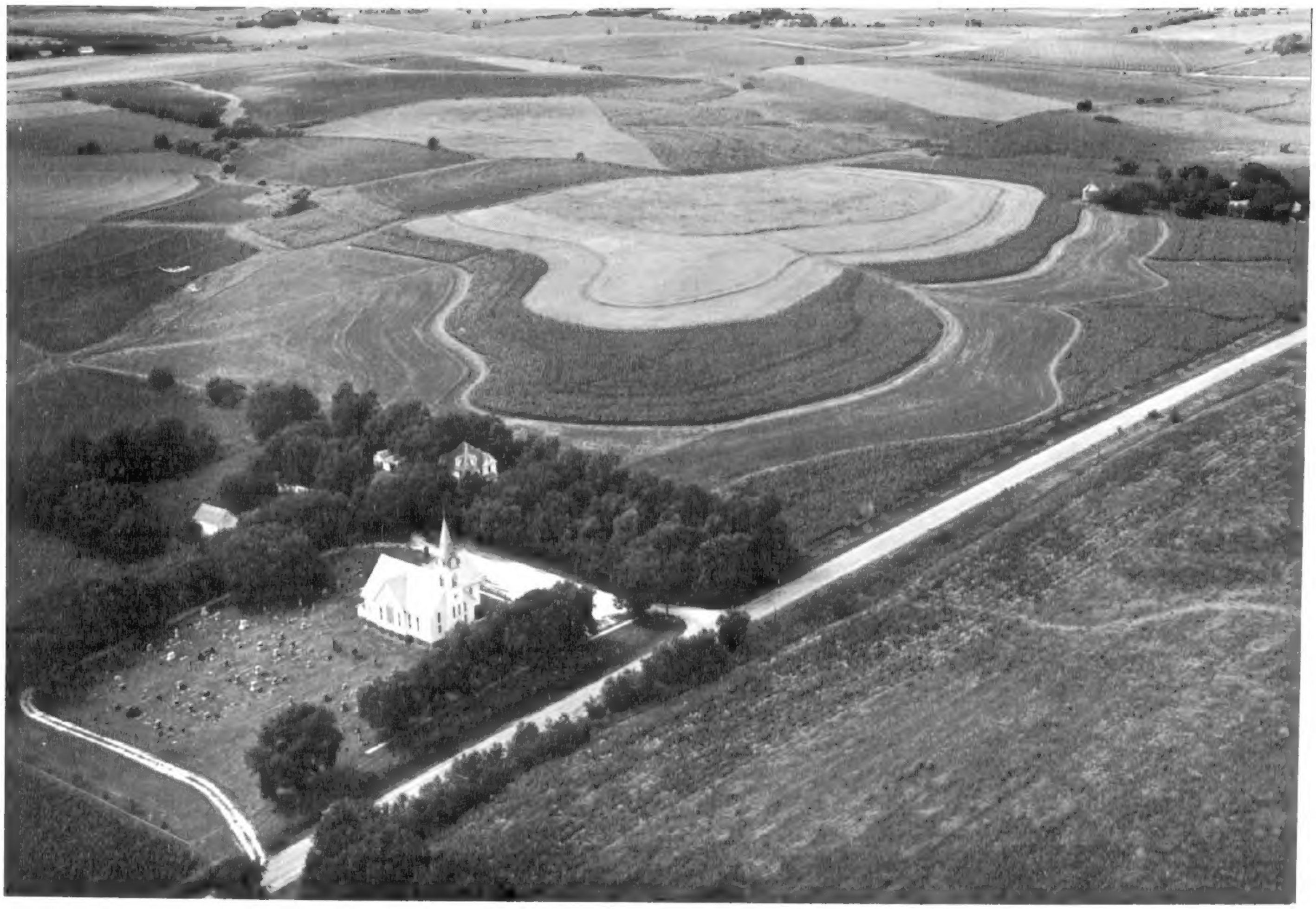
SOIL SURVEY

Saunders County Nebraska



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
UNIVERSITY OF NEBRASKA
CONSERVATION AND SURVEY DIVISION

Series 1959, No. 40

Issued January 1965

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of Saunders County will serve several groups of readers. It will help farmers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, ponds, and other structures; aid foresters in managing woodland; and add to our knowledge of soil science.

Locating Soils

Use the index to map sheets at the back of this report to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. When the correct sheet of the large map has been found, it will be seen that boundaries of the soils are outlined, and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they occur on the map. The symbol is inside the area if there is enough room; otherwise, it is outside the area and a pointer shows where the symbol belongs.

Finding Information

This report contains sections that will interest different groups of readers, as well as some sections that may be of interest to all.

Farmers and those who work with farmers can learn about the soils in the section "Descriptions of the Soils" and then turn to the section "Use and Management of the Soils." In this way, they first identify the soils on their farm and then learn how these soils can be managed and what yields can be expected. The "Guide to Mapping Units" at the back of the report will simplify use of the map and report. This guide lists the page where each soil and land type mapped in the county is described, the capability unit assigned to each soil and land type, and the page where each capability unit is described.

Foresters and others interested in trees and tree plantings can refer to the subsection "Management of Woodland." In that subsection the soils in the county are grouped in a table according to their suitability for trees in windbreaks. Factors affecting the management of windbreaks are explained.

Engineers and builders will want to refer to the subsection "Use of Soils in Engineering." Tables in that section show characteristics of the soils that affect engineering.

Scientists and others who are interested will find information about how the soils were formed and how they were classified in the section "Formation and Classification of Soils."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest. The section "General Soil Map" describes broad patterns of soils. The section "General Nature of the County" contains information on history, natural resources, climate, physiography, and other subjects.

* * * * *

Fieldwork for this survey was completed in 1959. Unless otherwise indicated, the statements in the report refer to conditions in the county at the time the survey was in progress. This survey is a result of State-Federal cooperation and is a part of the technical assistance furnished by the U.S. Department of Agriculture, Soil Conservation Service, to the Saunders County Soil Conservation District. Help in farm planning is available to farm owners and operators of Saunders County through the Saunders County Soil Conservation District, the county agricultural agent, or the Nebraska Agricultural Experiment Station.

Contents

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SOIL SURVEY OF SAUNDERS COUNTY, NEBRASKA

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UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH UNIVERSITY OF NEBRASKA, CONSERVATION AND SURVEY DIVISION

SAUNDERS COUNTY is located in the east-central part of Nebraska (fig. 1). It is almost square and has a land area of 756 square miles, or 483,840 acres. Wahoo, the county seat and largest town, is in the central part of the county. The climate of the county is continental and has wide seasonal and day-to-day variations. Winters are cold but not for long periods, and summers are hot.

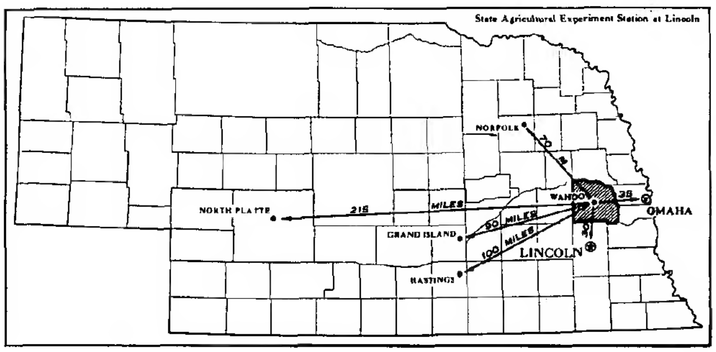

Figure 1.—**Location of Saunders County in Nebraska.**

Agriculture is the principal enterprise. The farming is diversified. Corn is the principal crop and is grown successfully in nonirrigated areas, as well as in irrigated ones. Soybeans, wheat, grain sorghum, and alfalfa are grown on most farms. Bromegrass is the most common tame grass and is grown for hay and pasture in legume-grass mixtures. A considerable part of the feed grains and forage crops grown in the county is eaten by beef and dairy cattle and by hogs. Some alfalfa is marketed through alfalfa drying mills. Soybeans and wheat are the cash crops.

How Soils Are Mapped and Classified

Soil scientists made this survey to learn what kinds of soils are in Saunders County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down to the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Judson and Sharpsburg, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in natural characteristics. Soils of one series can differ somewhat in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Judson fine sandy loam and Judson silty clay loam are two soil types in the Judson series. The difference in texture of their surface layer is apparent from their names.

Some soil types vary so much in slope, class of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Sharpsburg silty clay loam, 0 to 2 percent slopes, is one of several phases of Sharpsburg silty clay loam, a soil type that ranges from nearly level to strongly sloping.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of individual soils on aerial photographs. They used

photographs for their base map because they show woodlands, buildings, field borders, trees, and other details that greatly help in drawing boundaries accurately. The soil map in the back of this report was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, it may be better to show two or more similar soils as one mapping unit. In this county such groups are undifferentiated soil groups. For example, Shelby and Burchard clay loams, 6 to 12 percent slopes, is an undifferentiated soil group. Also, on most soil maps areas are shown that are so rocky, so shallow, or so frequently worked by wind and water that they scarcely can be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Gullied land or Riverwash, and are called land types rather than soils.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of the soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil survey reports. On the basis of the yield and practice tables and other data, the soil scientists set up trial groups and test them by further study and by consultation with farmers, agronomists, engineers, and others. Then, the scientists adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

As one travels over this county, he can see differences in the shape, steepness, and length of slopes, in the width of valleys, in the kinds of wild plants, and in the crops grown. With these more obvious differences in the landscape there are less easily noticed differences in the patterns of soils.

By drawing lines to separate these different patterns of soils, one may obtain a general soil map of the county. Such a map is the colored map at the back of this report. It shows the 11 soil associations, or distinct soil patterns in this county. Each association is named for the major soil series in it, but it includes soils of other series. In each soil association there are differences among the soils that are important to agriculture.

The general soil map lacks the precision required for accurately identifying the soils on a farm; it is not a substitute for the more detailed map that accompanies this report. It is, however, useful to those who want a general idea of the soils of this county, or who want to know the location of large areas suitable for a certain kind of farming or other land use.

Five of the 11 soil associations are strips of bottom land, as much as 3 or 4 miles wide, along the Platte River, Wahoo Creek, and their tributaries. The other six associations are broader areas on uplands.

1. Sarpy-Barney association: Well-drained to poorly drained soils in sandy alluvium on bottom lands

The soils in this association formed in sandy sediments that were deposited in nearly level areas dissected by many shallow streams. In many places wind shifted the sediments into hummocks before vegetation became established. Many areas of these soils are now well covered with grasses or a mixture of trees and grasses, and only in overgrazed or cultivated areas does the wind continue to shift these soils.

The well-drained Sarpy soils are on low hummocky slopes that are slightly higher than the surrounding soils (fig. 2). Poorly drained Barney soils are along the Platte River. Most areas are grazed. Sand reedgrass, sandhill bluestem, Indiangrass, and annual grasses grow on the drier sites. Kentucky bluegrass is the principal grass on the poorly drained sites, where there are also willow and cottonwood trees, sedges, and rushes. Also on the Sarpy and Barney soils are switchgrass, prairie cordgrass, wild gooseberry, dogwood, buckbrush, and many other native forbs and bushy shrubs.

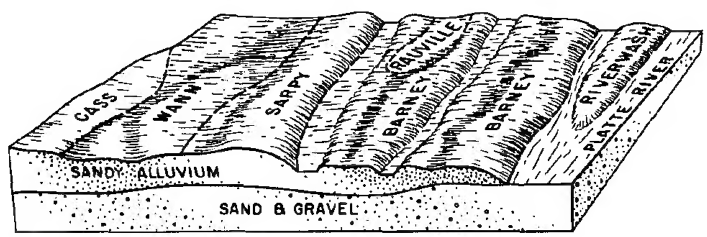

Figure 2.—**Soils in the Sarpy-Barney association.**

Among the sandy Sarpy and Barney soils in this association are small areas of poorly drained Rauville soils. These soils are in former stream channels and swales that have been slowly filled with silty and clayey materials. Prairie cordgrass, sedges, and rushes are dominant on Rauville soils, and there are lesser amounts of switchgrass and Kentucky bluegrass.

The Sarpy, Barney, and Rauville soils are usually in long narrow strips along stream channels. Each farm bordering the Platte River has a few acres of these soils, but only a few farms consist entirely of them. Only a few farmsteads and roads are in this association. Throughout this association are many gravel pits; sand and gravel deposited by the river are a few feet below the surface. Dredges pump the soils to screens that separate the sand and gravel. This removal of sand and gravel leaves large lakes or a series of small lakes. Hunting and

fishing privileges are often leased along these lakes and along the river. A few cabins are located in areas where trees and grasses are mixed, and interest in developing these areas for recreation is growing.

2. Leshara-Wann association: Imperfectly drained, silty and sandy soils in alluvium on bottom lands

The soils in this association formed in silt loam and sandy loam sediments that were deposited on the flood plains of the larger streams. Silty or sandy material extends from the surface to a depth of more than 20 inches and is underlain by a sand and gravel substratum. The association is nearly level but has many shallow swales that are old, partly filled stream channels. Surface drainage is slow because well-defined surface drains are few. The water table is generally 3 to 8 feet below the surface. In a year, the fluctuation in the water table is 2 to 4 feet. The water table is lowest late in summer and in fall.

Corn is the principal crop, but soybeans, sorghums, and alfalfa are also grown. Wetness is a problem in May and June if rainfall is above average, for planting is delayed and the control of weeds is often difficult. In years when rainfall is below average, grain and forage grow well because enough moisture is available from subirrigation. Summer droughts seldom damage the crops. The soils in this association do not produce yields as high as some of the better drained soils on bottom lands, but the yields are consistent from year to year.

The soils in this association are generally low in available phosphorus, and they benefit from applications of nitrogen fertilizer. They are calcareous at the surface or a few inches below the surface.

Included in this soil association are small areas of alkali soils, some of which are suitable only for plants tolerant of alkali. Also in the association are well-drained, highly productive Cass and Volin soils, and there are a few areas of poorly drained, silty Rauville soils, of clayey Luton soils, and of moderately clayey Lamoure soils (fig. 3).

The roads extend to nearly all areas in this association. The farmsteads are on the higher areas of Cass and Volin soils.

3. Lamoure-Rauville association: Imperfectly drained and poorly drained, moderately clayey soils in alluvium on bottom lands

The soils in this association formed from silty and clayey sediments that were deposited on flood plains of the larger streams. The association is nearly level but has many shallow swales that are partly filled channels of former streams. Surface drainage is very slow because well-defined natural drains are few. Some areas contain slight to strong concentrations of salts and alkali.

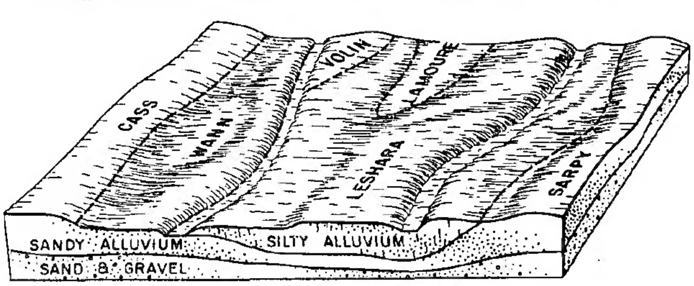

Figure 3.—Soils in the Leshara-Wann association.

Originally, most areas of Lamoure soils were too wet to be cultivated, but drainage has been improved by drainage ditches, road ditches, and tile drains, and now most areas are cultivated. The poorly drained Rauville soils are in the low areas (fig. 4) and produce coarse grasses that are used for hay or pasture.

Corn is the principal crop on the Lamoure soils, but wheat is grown successfully in areas that are seldom flooded or ponded. Spring small grains are seldom successful because the cold, wet soil slows their early growth. Because surface drainage is poor, the development of farmsteads is discouraged. Roads cross most of this association.

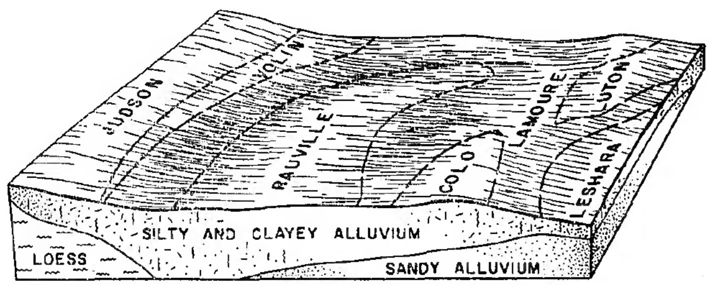

Figure 4.—Soils in the Lamoure-Rauville association.

4. Colo-Lamoure association: Imperfectly drained, moderately clayey soils in alluvium on nearly level bottom lands

The soils of this association formed in silty clay loam sediments that washed from the uplands and were deposited on the flood plains of the larger streams. The association is nearly level and has many shallow swales. Surface drainage is slow because well-defined drainageways are few. Occasionally, the streams overflow and cover the bottom land with a thin layer of dark-colored sediments. Crops usually are not damaged by this flooding, but the crops planted are those least damaged by flooding in spring and early in summer.

Corn is the principal crop. Wetness may delay planting on the Lamoure soils but seldom prevents it. The Colo soils are fertile and produce high yields year after year. Under dryland management, the nitrogen supply is usually adequate and the slight deficiency of phosphorus is easily corrected with fertilizer. Soybeans and sorghums are grown successfully. Wheat is grown, but it may be damaged by flooding early in summer. Alfalfa is grown successfully in areas that are seldom flooded.

Included in this soil association are small areas of Rauville soils that are too wet to be cultivated. Also in the association are Leshara soils that are less clayey than Lamoure soils, but otherwise similar, and well-drained Volin soils that are less clayey than Colo soils (fig. 5).

County roads lead to all areas of the association. Farmsteads are on the higher areas that are not subject to overflow. In upland areas channel improvement and water management are being started to lessen crop damage from flooding.

5. Sharpsburg-Fillmore association: Deep, dark, moderately clayey and clayey, nearly level soils

The soils in this association are on a loess-mantled

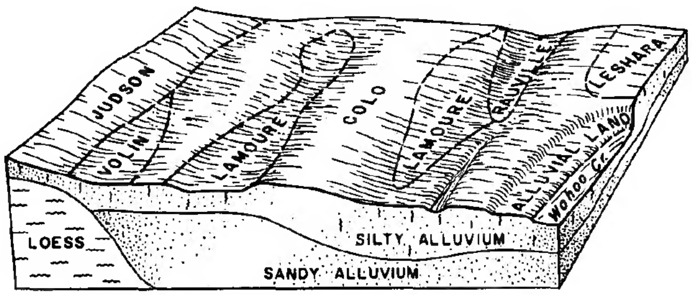

Figure 5.—**Soils in the Colo-Lamoure association.**

terrace called Todd Valley.[1] This valley, a former channel of the Platte River, is about 50 feet above the present level of the river and 75 to 100 feet below the uplands to the east and west. It is nearly level and has many slight swells and swales. A poorly defined and incomplete drainage pattern has developed, but most of the moisture that is not taken into the soils during rains collects in the swales. The Sharpsburg soils are on well-drained sites. The Fillmore soils are in the lowest parts of swales, and Butler soils are on the edges and on broad, low-lying flats (fig. 6). Ground water can be pumped and used for irrigation, and many farmers do this.

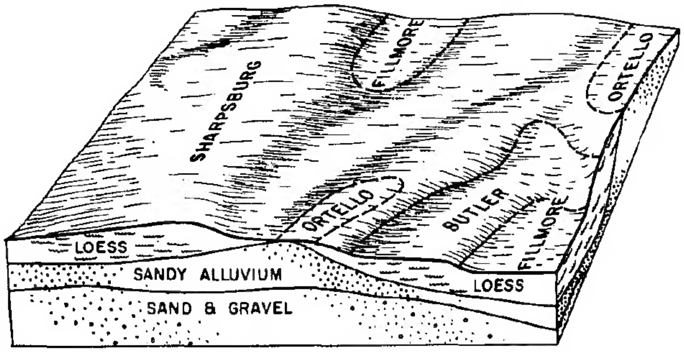

Figure 6.—**Soils in the Sharpsburg-Fillmore association.**

Corn, soybeans, and alfalfa are grown on the Sharpsburg soils under both dryland and irrigated management. Wheat and sorghums are important dryland crops. The Fillmore soils are so wet that they can be cultivated only if they are drained The Butler soils and drained Fillmore soils are less productive than the associated Sharpsburg soils, but they produce the same kinds of crops and require similar management. The undrained areas of Fillmore soils are ponded so frequently that cultivation is not practical. Native grasses and annual weeds grow in these wet areas, and if the areas are large enough to warrant fencing, they are grazed. The small areas of Fillmore soils in the cultivated fields of other soils are planted and harvested in years when they are not wet. When they are too wet, they are left in annual grasses or weeds. A few small areas of sandy Ortello soils are in Todd Valley and on the sloping edges of the bottom lands.

[1] Todd Valley, an abandoned valley of the Platte River, is a terrace 6 to 8 miles wide and 30 miles long. It extends diagonally across the east-central part of the county southeastward from the vicinity of Cedar Bluffs, near the northern border, to Ashland, near the southeastern corner of the county.

Roads, built on section lines, reach all parts of this association except for 25 square miles southeast of Mead that was occupied by the Nebraska Ordnance Plant during and following World War II. Part of this area is now used for military purposes, and the rest is an agricultural experiment station of the University of Nebraska.

6. Sharpsburg association: Deep, dark, well-drained, moderately clayey soils on uplands

From slightly rounded ridgetops in this association, smooth side slopes extend 400 to 800 feet. The slope of the ridgetops is 2 to 4 percent, and that of the side slopes is generally 6 to 12 percent. Surface drainage is good to excessive. Although the soils take in water readily, runoff is rapid during heavy rains and erosion is a major problem. The many small drainageways extend throughout the association and collect the dark-colored material that is washed from the slopes. Besides the Sharpsburg soils, Judson soils are in this association on the foot slopes, and Colo soils in the drainageways (fig. 7).

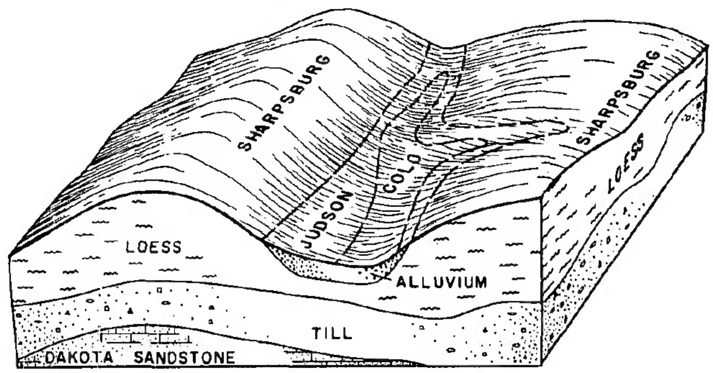

Figure 7.—**Soils in the Sharpsburg association.**

The soils in this association generally cannot be irrigated because ground water is not available for pumping and the soils are too sloping. Corn, wheat, alfalfa, and bromegrass are the principal crops, but soybeans and grain sorghum are also grown. Bromegrass is the dominant tame grass. It is generally grazed, but some is cut for hay and, when seed production is profitable, some is harvested for seed.

Most areas of these soils are deficient in nitrogen, and many severely eroded areas are deficient in zinc. Available phosphorous is medium to low, but potassium is available in adequate amounts. Applications of lime are beneficial in many areas.

In addition to the Sharpsburg, Judson, and Colo soils, there are small areas of other soils. These minor soils include soils in local alluvium along many small drainageways and soils that developed from sand and gravel of Pleistocene age, silt and sand of Aftonian age, and sandy and loamy materials of Dakota age.

Roads, built on section lines, extend to all parts of the association. Farmsteads are scattered throughout the association, but they are mainly in the less sloping areas.

7. Monona-Sharpsburg association: Deep, dark, well-drained, silty and moderately clayey soils on uplands

This soil association is made up of rounded ridgetops and of smooth side slopes 400 to 800 feet long (fig. 8).

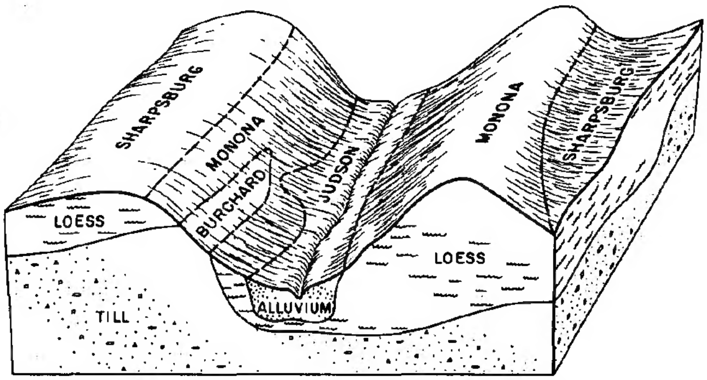

Figure 8.—**Soils in the Monona-Sharpsburg association.**

The slopes along the length of the ridgetops are 2 to 6 percent, but on the sides of the ridges they are generally 12 to 17 percent. Surface drainage is excessive. Although the soils take in water readily, runoff is rapid during heavy rains and erosion is a major problem. Small drainageways are widespread in the association, and they collect the dark-colored material that washes from the slopes.

The acreage of Monona soils is larger than that of the Sharpsburg soils. The Monona soils are slightly more friable in the surface layer than the Sharpsburg soils and are a little less clayey in the subsoil. These soils differ only slightly, however, and are managed and cropped in about the same way. Corn, grain sorghum, and wheat are the principal crops. Soybeans are grown in many of the less sloping areas. Sweetclover is often grown as a soil-building crop. Bromegrass is mainly grazed, but some is cut for hay or harvested for seed.

In addition to the Monona and Sharpsburg soils, there are small areas of soils that developed from glacial material and soils that developed from local alluvium in the upland drainageways.

The Monona-Sharpsburg association is generally steeper than the Sharpsburg association and has less cultivated land and more in permanent vegetation. Also, along upland drainageways, a larger acreage is neither cultivated nor grazed. The soils of this association are generally deficient in nitrogen and, in many severely eroded areas, are deficient in zinc. Available phosphorus is medium to very low, but available potassium is abundant. Some soils need additions of lime, but others have too much.

Roads, built on section lines, reach all parts of the association. Most roads are graveled, but improved roads are not so well maintained as they are in less sloping areas.

8. Sharpsburg-Burchard association: Deep, dark, well-drained, moderately clayey soils on uplands

The Sharpsburg soils, which developed from loess, are dominant in this association. About 20 percent of the association consists of Burchard, Shelby, Pawnee, Adair, Morrill, and Steinauer soils. These less extensive soils developed from glacial material that is exposed on slopes bordering the more deeply cut drainageways. Also in the association are small areas of Wymore soils, which have a more clayey subsoil than the Sharpsburg soils. Judson and Hobbs soils also occur (fig. 9).

The dominant Sharpsburg soils are cropped and managed in this association in about the same way as they

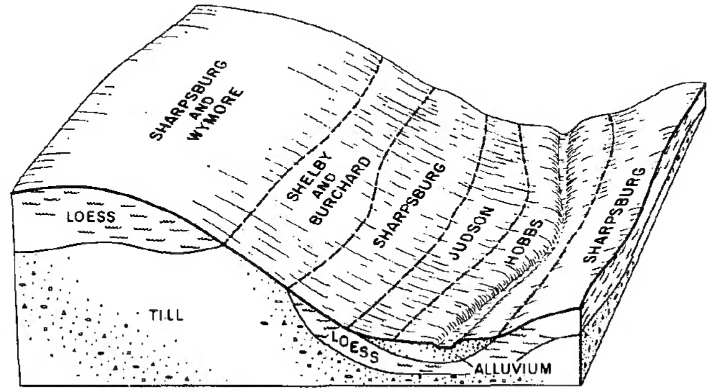

Figure 9.—**Soils in the Sharpsburg-Burchard association.**

are in the Sharpsburg association. Runoff has removed much of the surface layer from the soils in glacial material, and those soils are generally low in available phosphorus and nitrogen. Available potassium, however, is adequate. The Pawnee, Shelby, Adair, Morrill, and Burchard soils can be cultivated successfully if they are carefully managed. Grain sorghum and wheat are best suited. Corn grows well on the Shelby, Morrill, and Burchard soils, and yields of alfalfa are good on the Burchard soils. The Steinauer soil is steep, has a thin solum, and is not suited to cultivated crops. Most areas of this soil are in native grasses and are grazed.

Roads, built on section lines, reach all parts of this association. Most roads are graveled, and all-weather roads cross the association in an east-west and a north-south direction.

9. Burchard-Shelby association: Deep, dark, well-drained, moderately clayey and clayey soils on uplands

This association consists of soils that developed in glacial material and of soils that developed in loess. The Burchard, Shelby, Pawnee, Adair, Morrill, and Steinauer soils are in glacial material, and the Geary and Sharpsburg soils are in loess (fig. 10). In many places in the association, the geologic formations do not follow the normal sequence of Peorian loess on the ridgetops and Loveland loess and glacial material on the side slopes. Instead, many areas have Loveland material in the highest positions and Peorian material in the lower positions.

Nearly level and gently sloping ridgetops do not occur

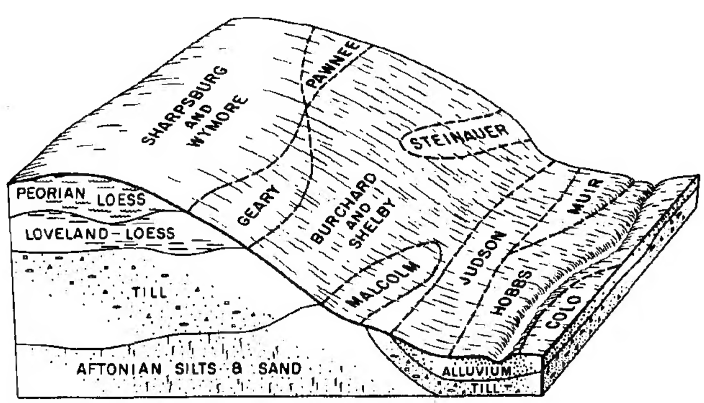

Figure 10.—**Soils in the Burchard-Shelby association.**

in this association. Fields are smaller and more irregularly shaped than elsewhere in the county. Trees grow along fence rows and in drainageways that are not mowed annually. Grain sorghum, wheat, and corn are the principal crops, and alfalfa and red clover are grown for hay. Areas in bromegrass and the many areas in native grasses are grazed.

The soils of this association are deficient in nitrogen and are medium to very low in available phosphorus. The supply of potassium is adequate. Burchard and Steinauer soils are slightly acid or neutral; the other soils are medium acid.

Roads are built on section lines, but the road system is not complete. Bridges are hard to maintain. The roads reach all areas, but some are little more than fenced lanes.

10. Monona association: Deep, silty soils on steep uplands

This soil association is made up of steep and very steep upland slopes that border the valley of the Platte River (fig. 11). The Monona soils are dominant, and there are small areas of Steinauer, Judson, and Leshara soils. The Monona soils have a very friable silt loam surface layer and subsoil. The surface layer is dark colored, and the subsoil is brown or pale brown. Many slopes are too steep for cultivation, and in a few places there is a bare, almost vertical cliff. The principal crops in cultivated areas are corn, alfalfa, and small grains. Yields are good year after year if the soils are carefully managed. Soil erosion is severe, however, and many eroded areas have been abandoned. Gully erosion is a serious problem because the drainageways are steep, and gully erosion is difficult to control once it starts.

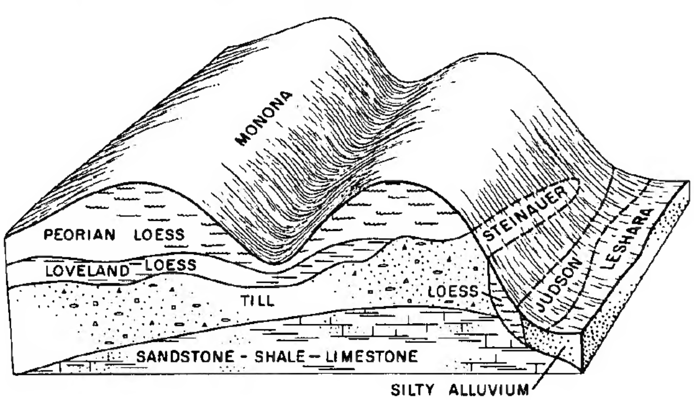

Figure 11.—**Soils in the Monona association.**

On the very steep slopes are trees or a mixture of grasses, shrubs, and trees. Oak, elm, ash, and cedar grow but are of little value. The association is grazed, and the forage ranges from abundant grasses of excellent quality in prairie areas to a small amount of browse in wooded areas. This association with its tree-covered, blufflike slopes, contrasts sharply with the level lowlands of the Platte River and the smooth slopes of the uplands.

The gully banks, road cuts, and nearly vertical slopes in the association expose geologic formations that range from recent loess through glacial materials to rocks of Pennsylvanian age. In only a few places is there available for study such a variety of materials that span so great a period of geologic time.

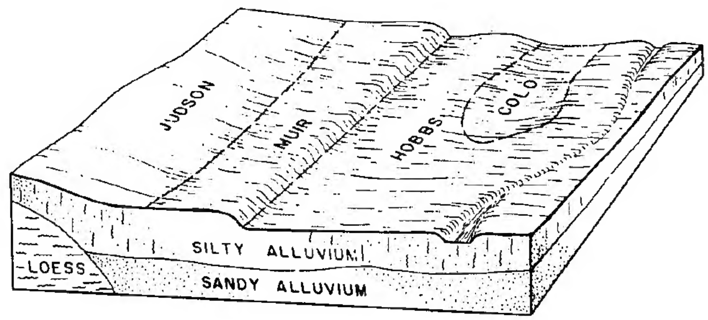

Figure 12.—**Soils in the Muir-Hobbs association.**

The roads, built on section lines, do not extend across this association. The association is more than a mile wide in only a few places and can be entered from roads that parallel it. Some points of access are at the brow of bluffs, but most are at the foot of slopes.

11. Muir-Hobbs association: Deep, silty to clayey soils on low terraces and on bottom lands that are flooded occasionally

The soils in this association formed from dark-colored sediments that washed from the adjacent uplands. Surface drainage is slow but adequate except in wet swales. The swales remain wet after a rain or overflow until the soils absorb the water. The soils are highly productive and easily managed.

Corn and soybeans are the principal crops, and alfalfa is grown in areas that are seldom flooded. Under dryland management, the nitrogen supply is generally adequate and the slight deficiency of phosphorus is easily corrected with fertilizer. The soils are neutral or slightly acid.

Included in this association are small areas of Colo soils (fig. 12), a few small areas of Rokeby soils, and small areas of silty soils that are frequently flooded. The Rokeby soils are not mapped separately in this county.

Descriptions of the Soils

This section describes, in nontechnical language, the soil series (groups of soils) and single soils (mapping units) of Saunders County. The approximate acreage and proportionate extent of each mapping unit are given in table 1.

The procedure in this section is first to describe the soil series, and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs. As mentioned in the section "How Soils Are Mapped and Classified," not all mapping units are members of a soil series. Alluvial land, Gullied land, Made land, Mixed alluvial land, Muck, and Riverwash are miscellaneous land types and do not belong to a soil series but, nevertheless, are listed in alphabetic order along with the soils series.

Following the name of each mapping unit, there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit and the windbreak suitability group in which the mapping unit has been placed. The page on which

each capability unit is described can be found readily by referring to the "Guide to Mapping Units," at the back of the report.

Soil scientists, engineers, students, and others who want detailed descriptions of soil series should turn to the section "Formation and Classification of Soils." Many terms used in the soil descriptions and other sections of the report are defined in the Glossary.

TABLE 1.—*Approximate acreage and proportionate extent of soils*

Map symbol	Soil	Area	Extent	Map symbol	Soil	Area	Extent
		Acres	*Percent*			*Acres*	*Percent*
AdC2	Adair clay loam, 6 to 9 percent slopes, eroded	669	0. 1	OrC2	Ortello complex, 6 to 12 percent slopes, eroded	2, 301	0. 5
AdD2	Adair clay loam, 9 to 12 percent slopes, eroded	638	. 1	OrE2	Ortello complex, 12 to 17 percent slopes, eroded	320	. 1
APD3	Adair and Pawnee soils, 6 to 12 percent slopes, severely eroded	6, 144	1. 3	PwC2	Pawnee clay loam, 6 to 9 percent slopes, eroded	1, 311	. 3
Sy	Alluvial land	10, 414	2. 2	PwD2	Pawnee clay loam, 9 to 12 percent slopes, eroded	924	. 2
B2	Barney soils	5, 948	1. 2	Pt	Platte loam	345	. 1
BSE	Burchard and Shelby clay loams, 12 to 17 percent slopes	1, 265	. 3	Ra	Rauville soils	3, 594	. 7
BSE2	Burchard and Shelby clay loams, 12 to 17 percent slopes, eroded	1, 465	. 3	Rw	Riverwash	131	(1)
BSE3	Burchard and Shelby clay loams, 12 to 17 percent slopes, severely eroded	844	. 2	Sa	Sarpy fine sand	1, 518	. 3
Bt	Butler silty clay loam	7, 148	1. 5	2Sa	Sarpy fine sand, hummocky	484	. 1
Cs	Cass fine sandy loam, moderately deep	437	. 1	Sg	Sarpy loamy fine sand	1, 572	. 3
3Cs	Cass fine sandy loam, deep	1, 646	. 3	2Sg	Sarpy loamy fine sand, imperfectly drained	150	(1)
Ct	Colo silty clay loam	37, 791	7. 8	4Sg	Sarpy loamy fine sand, loamy substratum	577	. 1
2Ct	Colo silty clay loam, clayey substratum	3, 218	. 7	ShA	Sharpsburg silty clay loam, 0 to 2 percent slopes	69, 632	14. 4
Fi	Fillmore silty clay loam	11, 432	2. 4	ShB	Sharpsburg silty clay loam, 2 to 4 percent slopes	6, 323	1. 3
2Fi	Fillmore silty clay loam, ponded	1, 639	. 3	ShC2	Sharpsburg silty clay loam, 4 to 6 percent slopes, eroded	59, 054	12. 2
GeC2	Geary silty clay loam, 6 to 12 percent slopes, eroded	254	. 1	ShD2	Sharpsburg silty clay loam, 6 to 12 percent slopes, eroded	75, 154	15. 5
GeC3	Geary silty clay loam, 6 to 12 percent slopes, severely eroded	208	(1)	ShD3	Sharpsburg silty clay loam, 6 to 12 percent slopes, severely eroded	25, 004	5. 2
GL	Gullied land	1, 494	. 3	ShE2	Sharpsburg silty clay loam, 12 to 17 percent slopes, eroded	588	. 1
Hz	Hobbs soils	6, 691	1. 4	ShE3	Sharpsburg silty clay loam, 12 to 17 percent slopes, severely eroded	1, 413	. 3
JfB	Judson fine sandy loam, 2 to 6 percent slopes	351	. 1	SWB	Sharpsburg and Wymore silty clay loams, 2 to 4 percent slopes	688	. 1
JtB	Judson silty clay loam, 2 to 6 percent slopes	20, 459	4. 2	SWC2	Sharpsburg and Wymore silty clay loams, 4 to 6 percent slopes, eroded	8, 552	1. 8
Lb	Lamoure silty clay loam	2, 638	. 5	SWD2	Sharpsburg and Wymore silty clay loams, 6 to 12 percent slopes, eroded	22, 482	4. 6
2Lb	Lamoure silty clay loam, alkali	1, 414	. 3	SWD3	Sharpsburg and Wymore silty clay loams, 6 to 12 percent slopes, severely eroded	12. 577	2. 6
Le	Leshara silt loam, deep	5, 973	1. 2	SWE2	Sharpsburg and Wymore silty clay loams, 12 to 17 percent slopes, eroded	757	. 2
2Le	Leshara silt loam, alkali	1, 235	. 3	SWE3	Sharpsburg and Wymore silty clay loams, 12 to 17 percent slopes, severely eroded	995	. 2
3Le	Leshara silt loam, moderately deep	2, 004	. 4	SBD	Shelby and Burchard clay loams, 6 to 12 percent slopes	451	. 1
Lu	Luton clay	854	. 2	SBD2	Shelby and Burchard clay loams, 6 to 12 percent slopes, eroded	1, 727	. 4
2Lu	Luton soils, saline	768	. 2	SBD3	Shelby and Burchard clay loams, 6 to 12 percent slopes, severely eroded	1, 303	. 3
ML	Made land	554	. 1	StE	Steinauer clay loam, 12 to 30 percent slopes	2, 298	. 5
MnD2	Malcolm silt loam, 6 to 12 percent slopes, eroded	294	. 1	Vo	Volin silt loam	2, 165	. 4
Sx	Mixed alluvial land	1, 334	. 3	Wb	Wann fine sandy loam, moderately deep	2, 365	. 5
MnC	Monona silt loam, 6 to 12 percent slopes	2, 438	. 5	2Wo	Wann fine sandy loam, alkali	776	. 2
MnC2	Monona silt loam, 6 to 12 percent slopes, eroded	5, 860	1. 2	3Wb	Wann fine sandy loam, deep	1, 784	. 4
MnE	Monona silt loam, 12 to 17 percent slopes	1, 972	. 4		Water	3, 906	. 8
MnE2	Monona silt loam, 12 to 17 percent slopes, eroded	9, 323	1. 9		Sand and gravel pits	147	(1)
MnF	Monona silt loam, 17 to 30 percent slopes	4, 289	. 9		Total	483, 840	100. 0
MhC2	Monona silt loam, sand substratum, 6 to 12 percent slopes, eroded	177	(1)				
MhE2	Monona silt loam, sand substratum, 12 to 30 percent slopes, eroded	349	. 1				
MrC2	Morrill clay loam, 6 to 12 percent slopes, eroded	496	. 1				
MrC3	Morrill clay loam, 6 to 12 percent slopes, severely eroded	908	. 2				
Mk	Muck	237	(1)				
Mt	Muir silty clay loam	7, 200	1. 5				

(1) Less than 0.1 acre.

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Adair Series

Soils in the Adair series developed in reddish-brown clayey material. They occur on strongly sloping to moderately sloping uplands, chiefly in the western part of the county, where they are associated with Pawnee soils. Except for their reddish-brown subsoil, Adair soils are similar to Pawnee soils.

The friable silty clay loam surface layer of Adair soils is 8 to 12 inches thick in uneroded areas. It is dark grayish brown and of fine granular structure. The upper subsoil is brown silty clay with blocky structure. The lower subsoil is reddish brown and, in most places, is more clayey than the upper subsoil. The substratum is reddish-brown or brown clay loam with weak, coarse, blocky structure. In most places lime concretions occur in the substratum. Throughout the profile are coarse sand grains, a few glacial pebbles and stones, and a very few boulders. Not enough stones and boulders occur to interfere with farming operations.

The areas of these soils in native sod are used for pasture or hay. Eroded areas are either cropped, or they have been cropped and reseeded to grass and are now used for pasture or hay. During hot, dry summers deep-rooted crops may be damaged because the clayey subsoil does not release water rapidly enough for good plant growth. The Adair soils are moderately acid to acid, low in nitrogen, and very low in available phosphorus. Agricultural limestone is used to reduce acidity, and fertilizer and farm manure are added to raise the level of nitrogen and phosphorus. Potassium deficiencies have not been observed in the Adair soils.

Adair clay loam, 6 to 9 percent slopes, eroded (AdC2).—This soil is on side slopes and, in a few places, is on rounded ridgetops. The surface layer is 4 to 8 inches thick. The subsoil is reddish-brown silty clay or clay that absorbs water very slowly. Because runoff is rapid on clean-tilled fields, erosion is a major problem in cultivated areas. Erosion can be controlled in these areas if soil amendments are added, and if practices are used that reduce the time the soil is not protected by growing plants or crop residues. Two or more tons of agricultural limestone per acre are needed if alfalfa or sweetclover is to grow successfully. Legumes, corn, and small grains respond well to phosphate fertilizer. Corn and small grains benefit from fertilizer and manure rich in nitrogen. Poor management results in low yields and increased erosion. (Capability unit IIIe-2; Silty to Clayey windbreak group)

Adair clay loam, 9 to 12 percent slopes, eroded (AdD2).—The strong slopes, severe erosion hazard, and generally low fertility make good management of this soil necessary. Unless such management is practiced, crop yields slowly decline and erosion continues until tilling the soil is no longer economically feasible. (Capability unit IVe-2; Silty to Clayey windbreak group)

Adair and Pawnee soils, 6 to 12 percent slopes, severely eroded (APD3).—This mapping unit consists of areas of Adair soil and of Pawnee soil that are so intermingled they cannot be shown separately on the soil map. Both soils have a clayey subsoil. Erosion has removed most of the original surface layer, and the plow layer is principally subsoil material. The original surface layer was friable and easy to till, but tillage is now difficult in the clayey subsoil material, which is hard when dry and plastic and sticky when wet. Small gullies are common. Both soils are moderately acid and are low in nitrogen and phosphorus. Use of these soils for native grass hay and pasture is preferable to use for tilled crops, bromegrass, or legumes. (Capability unit VIe-2; Silty to Clayey windbreak group)

Alluvial Land (Sy)

Alluvial land (0 to 2 percent slopes) is along the larger upland drainageways in nearly level areas that are flooded first whenever streams overflow their banks. These areas are usually flooded several times each year, when floodwaters flow rapidly across them and recede after a few hours. The soils are not wet or ponded for long periods, and ground water is usually more than 15 feet below the surface. The soil materials consist of light- and dark-colored silt loam and silty clay loam that contain thin lenses of sand and clay. The sediments deposited annually are in layers that range from a fraction of an inch to a foot or more in thickness. The vegetation consists of trees, woody shrubs, grasses, and tall annual weeds. Cultivation is difficult or impossible because of frequent flooding and numerous channels. Improving the stream channel and the watershed helps in reclaiming these areas for cultivation. (Capability unit VIw-1; Wetland windbreak group)

Barney Series

Soils of the Barney series are dark colored, poorly drained, and sandy. They developed in sandy alluvium on nearly level bottom lands along the Platte River.

The surface layer is very dark gray or dark gray, friable, granular fine sandy loam 6 to 15 inches thick. The subsoil is light-gray loamy sand or fine sand, and then changes abruptly to coarse sand and gravel at a depth of 20 to 30 inches. The water table rises to a point near the surface in the winter and spring, but it recedes into the sand and gravel during the growing season. Although these soils are wet part of the year, they have a low water-holding capacity and are droughty in dry seasons.

Nearly all areas of Barney soils are in native grasses used for hay or pasture. The wetter areas produce coarse grasses and rushes; some of the most recently deposited sediments support mixed grasses, cottonwood, and willow.

Barney soils (0 to 2 percent slopes) (B2).—In this mapping unit are Barney soils and small areas of similar sandy alluvial soils. These soils are not suitable for cultivation, because the water table is near the surface. The unsaturated part of the profile has enough lime in it to effervesce violently if dilute acid is applied.

Most areas are used for pasture. Many areas are overgrazed, but others are not grazed enough. Switchgrass, big bluestem, reedgrass, sedges, and rushes dominate in the native vegetation. Kentucky bluegrass invades the grazed areas. Among the growing plants are reedgrass and Indiangrass on the drier sites and cattails in the small marshy areas. Cottonwood and willow grow in open stands in the most recently deposited sediments adjacent to the river channel and along overflow channels. Kentucky bluegrass, sedges, and rushes grow under and between the trees. (Capability unit Vw-6; Wetland windbreak group)

Burchard Series

The soils of the Burchard series are well drained and have a clay loam or clay subsoil and a deep root zone. They developed in limy glacial material on moderately sloping to steep uplands throughout the southwestern part of the county and on slopes bordering the valley of the Platte River.

The surface layer, 6 to 16 inches thick, is very dark brown or very dark grayish-brown clay loam that has granular structure and is friable when moist (fig. 13). A few cobbles and many sand grains and small stones occur in many areas. The upper subsoil is dark grayish-brown clay loam or clay with blocky structure and firm consistence when moist. The lower subsoil is pale-brown or grayish-brown clay loam that grades gradually to light grayish-brown, calcareous glacial till. In the subsoil are many coarse sand grains, a few small stones, and a very few small boulders.

Soil erosion is a hazard because slopes are steep, runoff is rapid, and water enters the soil slowly. Many areas are used for pasture or hay, but corn, small grains, and alfalfa grow well if these soils are adequately fertilized.

Limestone generally is not needed, and if it is, the amount is small. Corn and small grains respond favorably to applications of nitrogen and phosphate fertilizers. Potassium deficiencies have not been observed in these soils.

Figure 13.—**Profile of Burchard clay loam.**

In this county Burchard soils are mapped with Shelby soils in a group of undifferentiated soils.

Burchard and Shelby clay loams, 12 to 17 percent slopes (BSE).—The surface layer of these soils is 8 to 12 inches of granular, friable clay loam. These soils occur on steep slopes covered by native plants. Erosion is slight and gullies are few, but if cultivated crops are grown, careful management is needed to keep the soil loss within allowable limits. (Capability unit IVe–1; Silty to Clayey windbreak group)

Burchard and Shelby clay loams, 12 to 17 percent slopes, eroded (BSE2).—These eroded soils have a surface layer that is 4 to 8 inches thick, or thinner than the corresponding layer in Burchard and Shelby clay loams, 12 to 17 percent slopes. Alfalfa, corn, and small grains may be grown successfully if these soils are carefully managed and fertilizer is added in amounts indicated by soil tests. (Capability unit IVe–1; Silty to Clayey windbreak group)

Burchard and Shelby clay loams, 12 to 17 percent slopes, severely eroded (BSE3).—All or nearly all of the original surface layer of these soils has been removed by erosion. The present surface layer is subsoil material that is difficult to till, is deficient in nitrogen and phosphorus, and absorbs water very slowly. Many shallow gullies and some deep ones are present. These soils are poorly suited to row crops or small grains. Grasses produce good yields of forage, and reestablishment of permanent vegetation is a practical and profitable practice on these soils. (Capability unit VIe–8; Silty to Clayey windbreak group)

Butler Series

Soils in the Butler series have a dark, friable surface layer and a compact, clayey subsoil. They developed in loess of Peorian age in level or slightly depressed areas. Surface drainage is slow. The Butler soils are most extensive in the Todd Valley, but areas generally too small to be shown on the soil map are on upland flats.

The friable silty clay loam surface layer is 10 to 18 inches thick. It is very dark grayish brown and has fine granular structure. The upper subsoil is black silty clay or clay that has blocky structure and is plastic when wet and very hard when dry. The lower subsoil is similar to the upper subsoil except that it is very dark gray instead of black. It grades to gray or brown silty clay loam at a depth of about 50 inches.

The surface layer of the Butler soils is acid and low to moderately low in available phosphorus and nitrogen. Although surface runoff is slow, these soils absorb water slowly. The subsoil is slowly permeable.

Butler soils respond well to good management, but they should be tested to determine rates for fertilization and liming. Additions of phosphate and nitrogen increase yields. Poor surface drainage can be improved by arranging crop rows so that excess water drains away. Irrigated areas of these soils require small and more frequent applications of water than do areas of soils that have a more permeable subsoil. Applying excessive nitrogen is wasteful because the slowly permeable subsoil permits denitrification.

Butler silty clay loam (0 to 2 percent slopes) (Bt).—This soil occurs on flats and slightly concave slopes in shallow depressions. It is associated with the Fillmore and Sharpsburg soils. Runoff from the higher lying

Sharpsburg soils often delays planting of small grains, corn, and soybeans and cultivation of corn and soybeans. Needed for increased yields are additions of lime to reduce acidity and additions of phosphate and nitrogen to increase fertility. Most areas of this soil are too small to be managed separately from the adjacent, more extensive Sharpsburg soils, but those areas large enough should be managed separately. (Capability unit IIs–2; Silty to Clayey windbreak group)

Cass Series

In the Cass series are dark, nearly level, well-drained soils that have a fine sandy loam subsoil. They developed in alluvial sediments on the Platte River bottom lands. Cass soils are better drained than the Wann soils and have a sandier subsoil than the Volin soils.

The fine sandy loam surface layer is 8 to 12 inches thick and has granular structure. The subsoil is dark-gray or brown fine sandy loam with weak blocky structure. Below a depth of 20 to 48 inches there are sandy and gravelly river sediments, in most places consisting of stratified loamy sand, sand, and gravelly sand that contain thin lenses of silt and clay.

The Cass soils are moderately deep and deep. Their surface layer is medium acid. The moderately deep soils have low water-holding capacity and are somewhat droughty in dry periods. All Cass soils are naturally deficient in phosphorus and nitrogen. A winter cover crop such as rye is needed on cultivated areas that might be unprotected from harvest to planting time.

Cass fine sandy loam, moderately deep (0 to 2 percent slopes) (Cs).—The root zone of this soil is only 20 to 36 inches thick and consists of loamy material over coarse sand or sand and gravel. The capacity for holding available water is so low that crops needing a large amount of water late in summer often do not produce highest yields. If sufficient moisture is available, this soil responds well to phosphate and nitrogen fertilizers. Lime is needed to reduce acidity. Shifting of the soil on the surface by the wind can be controlled by a continuous cover of plants or by plant residues. (Capability unit IIe–3; Sandy windbreak group)

Cass fine sandy loam, deep (0 to 2 percent slopes) (3Cs).—The root zone of this soil is more than 36 inches of loamy material. Consequently, this soil is less droughty than Cass fine sandy loam, moderately deep. Yields of corn, alfalfa, and other crops are high if fertilization is adequate. Although this soil is slightly less acid than the moderately deep Cass soil, lime is needed and should be added in amounts indicated by soil tests. This soil is easily tilled, and there are few management problems. Shifting of the soil on the surface by the wind can be controlled by a continuous cover of plants or plant residues. (Capability unit IIe–3; Sandy windbreak group)

Colo Series

Soils of the Colo series are dark, are moderately well drained or imperfectly drained, and have a silty clay loam subsoil. They are on nearly level bottom lands along the larger streams and upland drains, and they are flooded occasionally. Their subsoil is more clayey than that of the Volin soils, and they are not so well drained as the Cass or the Volin soils.

The surface layer is very dark gray or black, friable, granular silty clay loam 12 to 24 inches thick. The subsoil is slightly lighter colored than the surface layer and contains a little more clay. It is hard when dry and sticky when wet. The substratum is pale-brown or gray loam or sandy loam mottled with yellowish brown and dark brown, or at a depth of 36 to 50 inches, it is slowly permeable, gray, olive-gray, or black silty clay.

Planting or cultivation is frequently delayed by flooding, which deposits sediments that slowly build up the land surface, bury fences, fill drains and road ditches, and damage newly planted crops. Grasses and legumes are seldom grown in the areas flooded each year. Corn is the principal crop because its seedlings are subject to damage only for a short period when they are small. The frequent additions of dark-colored sediments keep the fertility high, and excellent yields can be expected when the crop is not damaged by flooding.

Colo silty clay loam (0 to 2 percent slopes) (Ct).—This soil is extensive on the nearly level bottom lands along the larger streams in the uplands. The damage to crops by flooding, or by wetness after flooding, is always a threat. High yields can be expected in 3 years out of 5, and a 25 to 50 percent reduction in yields the other 2 years. In some small areas flooding somewhat affects yields every year. Surface drains are needed in some areas to speed the removal of water trapped in swales. Soil tests should be used to determine the amount of fertilizer needed. Included with this soil are some areas of Rauville soils that have been drained. (Capability unit IIw–3; Silty to Clayey windbreak group)

Colo silty clay loam, clayey substratum (0 to 2 percent slopes) (2Ct).—This soil occurs on the bottom lands of the Platte River and along the larger streams in the uplands. It is imperfectly drained and dark colored. The depth to the clayey substratum ranges from 24 to 36 inches. Some small areas are saline, affected by alkali, or high in lime carbonate. These areas are called slick spots because their surface is slick when the soil is wet. This soil is low in available phosphorus in many places. It is generally neutral in the surface layer and has free lime in the subsoil.

This soil is managed in about the same way as the Lamoure silty clay loams. Open ditches are used to drain away excess water. Crops respond well to starter fertilizers containing nitrogen because the soil is wet and cold in spring and the nitrogen in the soil is therefore not available. Small grains are seldom grown, and alfalfa is not well suited. Corn is the main crop, but if wetness delays its planting, forage sorghum may be substituted. When a crop cannot be planted in spring, winter wheat may be seeded in fall. (Capability unit IIw–4; Moderately Wet windbreak group)

Fillmore Series

The soils of the Fillmore series occur in basins and shallow depressions mainly in the Todd Valley area. They have a dark, friable surface layer and a compact, clayey subsoil. Runoff from adjacent areas ponds in the basins and is slowly removed by evaporation and infiltration. Fillmore soils have a more clayey subsoil than Sharpsburg soils and poorer surface drainage than the Butler soils.

Figure 14.—**Profile of Fillmore silty clay loam.**

The surface layer is 6 to 12 inches of gray or black silt loam or silty clay loam with fine granular structure. It grades to a light-gray, very friable silt loam that is 4 to 10 inches thick and is lighter colored and coarser textured than the material above or below it (fig. 14). The subsoil is a very dark gray or black silty clay with blocky structure. It grades to gray silty clay, and that, in turn, to grayish-brown or light-gray silty clay loam that is generally stained with yellowish brown or dark brown.

Many areas of Fillmore soils are used for cultivated crops. Where the surface can be drained, fairly good yields of grain sorghum and small grains can be expected. Small grains and grasses are better suited to these soils than are deep-rooted crops and crops that grow throughout the growing season. These soils take in and release water slowly. Late in summer there is often not enough moisture available for high yields of corn, grain sorghum, and alfalfa. Irrigation provides supplemental water but does not raise the yields to the level obtained on the Sharpsburg soils. Undrained areas are in native or tame grasses and annual weeds are in the lowest part of the basins.

Fillmore silty clay loam (0 to 2 percent slopes) (Fi).—This soil is seldom ponded. Corn, grain sorghum, or small grains can be grown successfully in years that rainfall is not above normal in spring and early in summer. Runoff from the higher lying Sharpsburg and Butler soils adds to the water already in these soils and makes cultivation difficult. The fertility of these soils varies and can be determined best by soil tests. Nitrogen may be beneficial, and phosphate is probably needed. A light application of limestone is generally required, but potassium is deficient in only a few places. (Capability unit IIIw–2; Moderately Wet windbreak group)

Fillmore silty clay loam, ponded (2Fi).—This soil occurs in undrained depressions and basins. Water frequently stands on the surface following rains in spring and summer. The soil is best suited to grasses, but many areas are too small to be used for grazing. This soil occurs within cultivated fields of other soils in many areas and is planted with those soils unless it is too wet. If this soil is too wet, it is planted separately or kept idle. Areas that can be used for grazing produce fairly good yields of forage. (Capability unit IVw–2; Wetland windbreak group)

Geary Series

The Geary series consists of well-drained soils that developed on uplands in reddish-brown Loveland loess. These soils crop out in small areas in the moderately sloping southern part of the county.

The surface layer is brown silty clay loam 6 to 16 inches thick. It has a fine granular structure. The upper subsoil is silty clay loam that is brown to dark reddish brown when moist. It has weak subangular blocky structure. The lower subsoil is similar to the upper subsoil in color, but in most places it is clay loam instead of silty clay loam. It is underlain by weathered, reworked glacial material at a depth of 24 to 48 inches.

The Geary soils are productive, and if managed well, produce about the same yields as the Sharpsburg soils. Water erosion is likely, and practices are needed to control the loss of soil and water. These soils respond well to nitrogen and phosphate fertilizers. They are noncalcareous and benefit from applications of lime. Severely eroded areas are very low in fertility.

Geary silty clay loam, 6 to 12 percent slopes, eroded (GeC2).—This soil has lost 4 to 10 inches of the original dark-colored surface layer through erosion. Further erosion and the loss of water can be controlled by terracing, by grassing the waterways, and by other practices. Because the soil is acid, additions of lime are needed. This soil is low in phosphorus and responds well to nitrogen fertilizer. (Capability unit IIIe–1; Silty to Clayey windbreak group)

Geary silty clay loam, 6 to 12 percent slopes, severely eroded (GeC3).—This soil has lost its original surface layer through erosion, and its present surface layer is brown to dark reddish-brown silty clay loam. To conserve soil and water, terracing, grassing the waterways, growing grasses and legumes, and other practices are needed. Also needed on this acid soil are additions of lime. The content of phosphorus and nitrogen is very low. If this soil is well fertilized and otherwise adequately managed, it is suited to all crops grown in the county, but only a small amount of row crops should be grown. (Capability unit IVe–8; Silty to Clayey windbreak group)

Gullied Land (GL)

Gullied land is in moderately sloping areas in which erosion has removed the surface layer and subsoil and

gullies have cut into the parent material (fig. 15). The gullies will continue to widen and lengthen unless runoff is controlled by diversions, drop structures, or stabilized water channels, or is held behind a dam. These areas are less than 10 acres in most places and are useless for farming.

In areas where runoff is controlled, Gullied land can be smoothed and planted to shrubs, trees, or grasses. These areas can then be fenced and used for wildlife. Trees and shrubs can be established without difficulty, but they must be planted and cultivated by hand. Fertilizer is needed in establishing and maintaining stands of grass. Gullied land is not suitable for orchards and vineyards, for they require large areas in which machinery can be used. If Gullied land is made into wildlife areas, protection against further erosion will be provided, and the land will be used in a way that requires a minimum of labor. (Capability unit VIIe-1; Silty to Clayey windbreak group)

Hobbs Series

The soils in the Hobbs series occur on the flood plains along the major streams and narrow upland drainageways. These soils are deep, dark colored, and nearly level, and they have a silt loam or silty clay loam surface layer and subsoil. Flooding occurs once or twice each year along the major streams and more frequently along the narrow upland drains, but it seldom damages crops. The depth to the water table ranges from 6 to many feet.

The surface layer is dark-colored, friable, granular silt loam or silty clay loam 10 to 16 inches thick. The subsoil is similar to the surface layer and is moderately permeable and favorable for the growth of plants.

Hobbs soils are easily tilled. Their fertility is higher than the average for soils on the uplands in the county. Their water-holding capacity is high, and they receive additional moisture from floods. Each flood generally adds a thin layer of dark-colored sediments that washed from the uplands, but in some areas the sediments are from eroded slopes and are light colored.

Hobbs soils (0 to 2 percent slopes) (Hz).—The surface layer of these soils is silt loam or silty clay loam that has been deposited recently and varies in thickness and color.

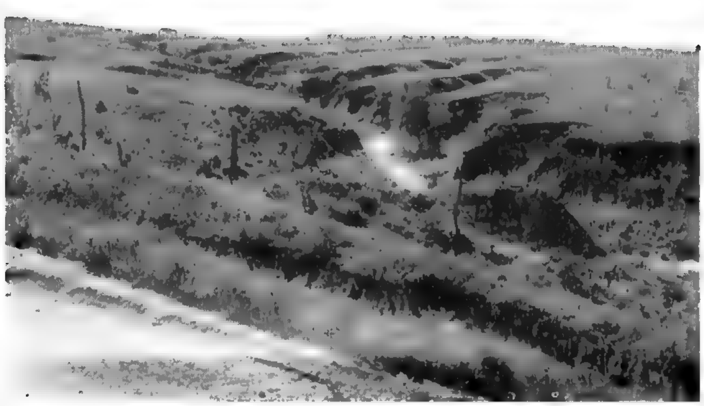

***Figure 15.*—Gullied land.**

The soils are slightly acid or neutral. Although fertility is generally high, soil tests are needed because, in some fields, fertilizer is needed to supplement the natural nutrients. (Capability unit IIw-3; Silty to Clayey windbreak group)

Judson Series

The soils of the Judson series occur on foot slopes that border stream terraces, bottom lands, and small upland drains. They have a thick, dark, friable surface layer and a moderately clayey subsoil.

The surface layer is dark-gray, friable fine sandy loam or silty clay loam with granular structure. The dark-colored material grades to dark grayish brown at a depth of more than 20 inches and then to a brown silty clay loam that contains slightly more clay than the surface layer.

Judson soils are easily tilled and are more fertile than most soils on the uplands in the county. Their water-holding capacity is high, and runoff from higher areas supplies additional moisture. This additional moisture is beneficial in most years because crop production is often limited by lack of moisture. Flooding damages crops slightly in some areas.

Judson silty clay loam, 2 to 6 percent slopes (JtB).—This is a deep, well-drained, fertile soil that is medium acid. Its surface layer is a dark, friable silty clay loam that is easily tilled. Under good management that includes applications of fertilizer in amounts indicated by soil tests, yields are good for all crops grown in the county. (Capability unit IIe-1; Silty to Clayey windbreak group)

Judson fine sandy loam, 2 to 6 percent slopes (JfB).—This soil has a coarser textured surface layer than Judson silty clay loam, 2 to 6 percent slopes, but the two soils are similar in most other respects. It occurs on the lower slopes at the edge of Todd Valley and along some of the drainageways that cross the valley.

The surface layer is grayish-brown fine sandy loam 8 to 16 inches thick. It grades abruptly to dark-colored silty clay loam that is similar to the material in comparable horizons of Judson silty clay loam, 2 to 6 percent slopes. Management should include practices that prevent the wind from shifting the sandy surface layer. The soil is medium acid. Because fertility has been affected by past management, soil tests are needed to determine the present fertilizer requirement. (Capability unit IIIe-3; Sandy windbreak group)

Lamoure Series

The soils in the Lamoure series developed in water-deposited sediments on nearly level, imperfectly drained bottom lands along the Platte River and large upland drains.

The surface layer is black silty clay loam that is granular and 12 to 18 inches thick. It is hard when dry and sticky when wet. If the soils are tilled when they are wet, large, hard clods form that make preparing a good seedbed difficult. The subsoil is black in the upper part and very dark gray in the lower part. It is silty clay in most places but ranges from silty clay loam to silty clay. Structure is granular to blocky, and free lime carbonate occurs in slight to moderate amounts. The substratum is generally streaked and stained with gray, yellowish brown, and brown. In many places lime carbonate occurs as

hard concretions. Water generally collects in a hole dug to a depth of 4 feet or more. In spring the water may rise within 2 feet of the surface, but it recedes to a depth of 4 to 6 feet during summer and fall.

Lamoure silty clay loam (0 to 2 percent slopes) (Lb).—This is a deep, dark-colored soil that produces moderate to high yields of corn, grain sorghum, and wheat in years of nearly normal rainfall. However, in years when rainfall is above normal, planting is often delayed and crop yields are reduced 50 percent or more. Drainage is the main management problem. Water can be drained from the surface by shallow open ditches, and tile drains are practical in some areas. In many areas, however, the high water table and the lack of a suitable outlet prevent the use of tile.

These soils are generally low in phosphorus. Wheat responds somewhat to applications of nitrogen, and corn to starter fertilizer. Because individual fields and farms vary, soil tests help to determine the amount of fertilizer needed. (Capability unit IIw–4; Moderately Wet windbreak group)

Lamoure silty clay loam, alkali (0 to 2 percent slopes) (2Lb).—This soil has enough alkali salts to lessen crop yields, but in other respects it is similar to Lamoure silty clay loam. In scattered areas called slick spots or scab spots, hardly any crop can be grown. These slick spots are 20 to 100 feet in diameter. Although the soil between them is only slightly to moderately affected by the alkali salts, the alkali is widespread enough to be a controlling factor in management.

Drainage is needed if the alkali is to be reduced. Then crops that tolerate moderate concentrations of alkali are suitable. Soil tests help to determine the amount of phosphate and nitrogen fertilizers needed. The slick spots respond well to heavy applications of manure. (Capability unit IIIs 1; Moderately Saline-Alkali windbreak group)

Leshara Series

The soils of the Leshara series developed in water-deposited sediments on nearly level, imperfectly drained bottom lands along the Platte River and large upland drains.

The surface layer is very dark gray silt loam that is granular and 8 to 16 inches thick. The subsoil is also granular and is dark grayish brown in the upper part and grayish brown in the lower part. It is very fine sandy loam, silt loam, or light silty clay loam but is silt loam in most places. Lime carbonate occurs in slight to moderate amounts. The substratum is streaked and stained with gray, yellowish brown, and brown. Soft or hard concretions of lime carbonate occur in pores and openings. Water generally collects in a hole dug to a depth of 5 feet or more. In spring the water table may rise to within 3 feet of the surface, but it recedes to a depth of 5 to 7 feet during summer and fall.

Leshara silt loam, deep (0 to 2 percent slopes) (Le).—This is a deep, dark-colored soil that produces moderate to high yields of corn, grain sorghum, and wheat in years when rainfall is nearly normal. However, in years of above normal rainfall, planting is often delayed and crop yields are reduced 50 percent or more. Drainage is a major problem. Water can be drained from the surface by shallow open ditches, and tile drains are practical in some areas. In many areas, however, the high water table and the lack of a suitable outlet prevent the use of tile.

These soils are generally low in phosphorus. Wheat responds somewhat to applications of nitrogen, and corn to starter fertilizers. Because individual fields and farms vary, soil tests help to determine the amount of fertilizer needed. (Capability unit IIw–4; Moderately Wet windbreak group)

Leshara silt loam, moderately deep (0 to 2 percent slopes) (3Le).—This soil differs from Leshara silt loam, deep, in having a sand and gravel substratum at a depth of only 24 to 36 inches. It requires about the same management, but produces lower crop yields. (Capability unit IIw–4; Moderately Wet windbreak group)

Leshara silt loam, alkali (0 to 2 percent slopes) (2Le).—This soil is similar to Leshara silt loam, deep, but it contains so much alkali that only alkali-tolerant crops can be grown. Corn, grain sorghum, wheat, and alfalfa are not suited. Rye and sweetclover grow fairly well in the areas least affected by the alkali salts. The surface layer is high in exchangeable sodium. The alkali is strong in 60 to 75 percent of the area. Intermingled with this strongly alkali soil are Leshara soils that are free of alkali salts or are only moderately affected.

The water table does not fluctuate so much as in the other Leshara soils and, except in periods when rainfall is below normal, is seldom below 4 feet. Dissolved salts are left on or near the surface when the water table rises and the water evaporates or is used by plants. Because the surface layer is high in exchangeable sodium, tilling and preparing a satisfactory seedbed are difficult. Management should include practices to remove the alkali present and to lower the water table so that additional salts do not accumulate. (Capability unit VIs–1; Moderately Saline-Alkali windbreak group)

Luton Series

The soils in the Luton series are imperfectly drained, dark colored, and clayey. They developed in nearly level alluvial deposits in swales and on basinlike flats on the broad bottom lands of Wahoo Creek and the Platte River. They are seldom flooded by water from the streams, but they collect runoff from adjacent areas. These soils probably developed under poor drainage, but drainage has been improved by road ditches, shallow surface drains, and in some places by deeper ditches.

The surface layer is very dark gray silty clay or clay that is granular and 6 to 12 inches thick. The subsoil is very dark gray or black silty clay or clay and has blocky structure. Free lime carbonate is in the subsoil in some places. Below a depth of 30 to 40 inches, these soils are slightly lighter colored and less clayey than they are above that depth.

Luton clay (0 to 2 percent slopes) (Lu).—Most areas of this soil are in corn, wheat, or soybeans. The clayey texture, low permeability, and inadequate surface drainage make the soil cold, wet, sticky, and difficult to till in spring. In years of normal rainfall, however, yields are equal to or above the average for the county. When rainfall is above average, planting is delayed, and when it is below average, preparing a good seedbed and obtaining a uniform stand are difficult. When the soil dries out, it cracks and is somewhat droughty. Included

with this soil are some areas of Rauville soils that have been drained.

Providing surface drainage is important, but equally important are tilling when the weather is good and selecting suitable crops. Although fertility is high, soil tests are needed to determine slight deficiencies in plant nutrients that may exist. Some areas have been limed to neutralize the medium acid surface layer. Starter fertilizers help crops planted in spring. (Capability unit IIIw–1; Moderately Wet windbreak group)

Luton soils, saline (0 to 2 percent slopes) (2Lu).—These soils have a generally high concentration of saline and alkali salts that distinguish them from Luton clay and, together with their clayey texture and imperfect drainage, make them unsuited to tilled crops. These soils are best suited to perennial grasses that are tolerant of salts. In some areas the concentration of salts is only moderate. (Capability unit VIs–1; Moderately Saline-Alkali windbreak group)

Made Land (ML)

Made land consists of dumps of waste material, spoil banks along drainage ditches, and piles of soil materials around gravel and sand pits. Some of these areas have been disturbed recently and are not covered with growing plants; others are partly covered with weeds and grasses. In time all areas of Made land probably will be covered with weeds, trees, and grasses and will provide cover for birds and small animals. (Capability unit VIIs-1; Silty to Clayey and Very Sandy windbreak groups)

Malcolm Series

The soils in the Malcolm series are friable, dark colored, and well drained. They developed on uplands in silts that were deposited before the advance of the Kansan glacier. They occur with the Morrill and Shelby soils but are free of stones and pebbles of glacial origin. Malcolm soils are more friable than Sharpsburg soils.

The surface layer is very dark grayish-brown silt loam or silty clay loam that is granular and 6 to 12 inches thick. The subsoil is dark grayish-brown or brown silty clay loam with weak blocky structure. The substratum is gray or pale-brown silt or very fine sand.

These soils are of minor extent and are not important agriculturally. Because the substratum is as much as 90 percent silt, material from it is used in mixtures for highway construction.

Malcolm silt loam, 6 to 12 percent slopes, eroded (MnD2).—This soil occurs in small areas on upland slopes. It is generally low in phosphorus and nitrogen and should be tested to determine the kinds and amounts of fertilizer needed. All crops except alfalfa respond well to nitrogen fertilizer. Because this soil occurs in small areas within larger areas of Shelby, Morrill, and Sharpsburg soils, and because it needs management similar to that needed on those soils, it is managed in about the same way as those soils. (Capability unit IIIe–1; Silty to Clayey windbreak group)

Mixed Alluvial Land (Sx)

Mixed alluvial land consists of sandy and silty soils ntermingled on nearly level slopes that border the channel of the Platte River. Some areas of this land are crossed by channels that have shallow water in them when the river is high. Water-tolerant bluegrass, sedges, and willow are dominant in the imperfectly drained areas, and switchgrass, bluegrass, and cottonwood grow in the moderately well drained areas.

The dark-colored surface layer is somewhat loamy and extends to a depth of 6 to 15 inches. A silty to very sandy subsoil is underlain by coarse sand or by sand and gravel. The combined thickness of the surface layer and subsoil ranges from 8 to 20 inches.

This land is low in fertility, low in water-holding capacity, and not well suited to cultivation. Areas in grass are grazed, and areas mainly in trees are either grazed or left idle. The trees have no value as wood products. (Capability unit VIw–5; Moderately Wet windbreak group)

Monona Series

The soils in the Monona series are deep, dark colored, and friable. They developed from pale-brown and light-gray loess on upland slopes of 6 to 30 percent.

The surface layer is very dark grayish-brown silt loam or silty clay loam 6 to 12 inches thick (fig. 16). The

Figure 16.—**Profile of a Monona silt loam exposed in a road cut.**

subsoil is brown or grayish-brown, friable silty clay loam. Weathering is slight in the gray or pale-brown silt loam or sand substratum.

Monona soils are easily tilled and, under good management, produce moderate to high yields of corn, sorghums, small grains, and alfalfa. The soils are low in phosphorus, nitrogen, and organic matter. Potassium is adequate, but lime is needed in some places. The many severely eroded areas are very low in phosphorus and nitrogen and are low in zinc in some places, but generally do not need lime.

Because slopes are moderate to steep and runoff is rapid, the control of erosion is a major probelm in cultivated areas. To control erosion, a cropping system that gives maximum protection should be used, together with stripcropping, terracing, grassing the waterways, and other practices.

Monona silt loam, 6 to 12 percent slopes (MnC).—This soil occurs on rounded ridgetops. It is the most productive Monona soil in the county and, under good management, produces moderate to high yields. Corn, wheat, and alfalfa are the principal crops, but soybeans, grain sorghum, spring small grains, and pasture grasses are also grown. (Capability unit IIIe-1; Silty to Clayey windbreak group)

Monona silt loam, 6 to 12 percent slopes, eroded (MnC2).—This soil has a thinner surface layer than Monona silt loam, 6 to 12 percent slopes. In many areas all of the original dark surface layer has been removed through erosion. Crop yields are lower in these areas than they are in the less eroded ones. To increase crop yields to those on the less eroded soils, careful management that includes the addition of amendments and intensive erosion control are needed. (Capability unit IIIe-8; Silty to Clayey windbreak group)

Monona silt loam, 12 to 17 percent slopes (MnE).—This soil is similar to Monona silt loam, 6 to 12 percent slopes, except for its stronger slopes that cause a slightly greater erosion hazard in cultivated areas. (Capability unit IVe-1; Silty to Clayey windbreak group)

Monona silt loam, 12 to 17 percent slopes, eroded (MnE2).—This soil is similar to Monona silt loam, 6 to 12 percent slopes, eroded, except for its stronger slopes that cause a greater erosion hazard in cultivated areas. (Capability unit IVe-8; Silty to Clayey windbreak group)

Monona silt loam, 17 to 30 percent slopes (MnF).—This soil occurs on the blufflike slopes that border the bottom lands of the Platte River. Trees and grasses cover most of this soil, but some areas on slopes of 17 to 20 percent are cultivated. Yields are low, and soil losses through erosion are high. The soil is best suited to grasses or trees that provide a permanent cover. (Capability unit VIe-1; Silty to Clayey windbreak group)

Monona silt loam, sand substratum, 6 to 12 percent slopes, eroded (MhC2).—This soil is more sandy than Monona silt loam, 6 to 12 percent slopes, and its substratum is fine sand instead of silt loam. Although of small extent in the county, this soil creates a problem on the farms where it occurs. It is low in plant nutrients, and plant cover is sparse in many places. Control of erosion is more essential on this soil than on the silty Monona soils with comparable slopes. In some areas gullies have cut into the loose sand substratum and are difficult to check before they cut into adjacent areas of productive soils. Under good management, fair yields of corn, grain sorghum, and alfalfa are obtained. (Capability unit IVe-8; Silty to Clayey windbreak group)

Monona silt loam, sand substratum, 12 to 30 percent slopes, eroded (MhE2).—This soil is steeper and more susceptible to erosion than Monona silt loam, sand substratum, 6 to 12 percent slopes, eroded. Cultivated fields should be converted to permanent vegetation. Gullied areas and eroding drainageways should be shaped, seeded, and fenced to keep out livestock. Gullies that are allowed to go unchecked widen and lengthen and destroy adjacent soils. (Capability unit VIe-8; Silty to Clayey windbreak group)

Morrill Series

The Morrill series consists of deep, dark-colored soils that developed in sandy, friable glacial drift. These soils occur on slopes with the Geary, Shelby, and Adair soils.

The surface layer is very dark grayish-brown loam or clay loam that has granular structure and is 8 to 15 inches thick. The subsoil is reddish-brown clay loam with blocky structure. It grades gradually to a substratum of reddish-yellow sandy loam or sandy clay loam. These soils are noncalcareous to a depth of 5 feet or more.

Morrill soils are easily tilled, and under good management they produce moderate yields of corn, sorghums, small grains, and alfalfa. The soils are medium acid and are low in phosphorus, organic matter, and nitrogen. The supply of potassium is adequate. Because slopes are moderate and runoff is rapid, the control of erosion is a major problem in cultivated areas. To control erosion, a cropping system that gives maximum protection should be used, together with stripcropping, terracing, grassing the waterways, and other practices. Yields of forage from native and tame grasses are moderate to high.

Morrill clay loam, 6 to 12 percent slopes, eroded (MrC2).—About half of the original surface layer of this soil has been removed through erosion, and the present surface layer is very dark grayish brown. Corn, grain sorghum, spring small grains, and alfalfa are the principal crops. Lime is needed to correct the acidity, and yearly applications of phosphate and nitrogen fertilizers benefit grain crops. (Capability unit IVe-1; Silty to Clayey windbreak group)

Morrill clay loam, 6 to 12 percent slopes, severely eroded (MrC3).—This soil is similar to Morrill clay loam, 6 to 12 percent slopes, eroded, except that all or nearly all of the original dark-colored surface layer has been removed through erosion. The present surface layer is reddish-brown clay loam that formerly was the subsoil. The soil is very low in phosphorus, nitrogen, and organic matter. It contains an adequate supply of potassium, but the supply of zinc may be low. Profitable yields can be obtained only if erosion is controlled. (Capability unit IVe-8; Silty to Clayey windbreak group)

Muck (Mk)

Muck is nearly level, imperfectly drained, and dark colored. It developed in stratified alluvium and peaty material that accumulated in marshes or shallow lakes on the bottom lands of the Platte River.

The surface layer is black silt loam and partly decomposed organic material that makes up 10 to 20 percent of

the volume. It is 12 to 20 inches thick. The subsoil is dark-colored, silty alluvium that contains layers of peat or muck. The substratum is generally silt or clay but is sand or sand and gravel in some places.

Corn and soybeans are the principal crops. Wheat and alfalfa are not grown successfully. (Capability unit IIw-4; Moderately Wet windbreak group)

Muir Series

In the Muir series are deep, dark-colored, well-drained soils that developed in silt loam and silty clay loam alluvium. These soils are seldom flooded by streams but are occasionally flooded by runoff from adjacent uplands that does not damage crops. Although these infrequent floods delay planting, they add moisture that benefits crops later in the growing season.

The surface layer is very dark brown silty clay loam that has granular structure and is 10 to 20 inches thick. The subsoil is very dark grayish-brown or dark grayish-brown silty clay loam.

These soils are fertile, and they produce high yields of corn, grain sorghum, wheat, soybeans, and alfalfa if enough moisture is available. Forage yields of tame and native grasses are also high.

The soils are slightly acid and contain a medium amount of phosphorus. The content of nitrogen is adequate in some fields and is slightly deficient in others, depending on past management.

Muir silty clay loam (0 to 2 percent slopes) (Mt).—This soil occurs on nearly level stream terraces. It is well suited to cultivated crops, and nearly all areas are cultivated. (Capability unit I-1; Silty to Clayey windbreak group)

Ortello Series

In this series are sandy soils that developed from sandy alluvium. These soils occur on hummocks and ridges in the Todd Valley and in narrow bands on the sloping edges of the valley.

The surface layer is very dark brown loam or fine sandy loam 6 to 16 inches thick. The subsoil is very dark grayish-brown or brown sandy loam. It grades to yellowish-brown sandy loam, loamy sand, or sand that contains some gravel below 30 to 40 inches.

These soils are leached of lime to a depth of 5 feet. The surface layer is medium acid. The content of phosphorus and of organic matter is medium or low. Cultivated areas of these soils are susceptible to wind and water erosion.

Ortello complex, 6 to 12 percent slopes, eroded (OrC2).—This complex consists of slightly eroded, moderately eroded, and severely eroded Ortello loam and Ortello fine sandy loam. In some places the substratum ranges from sandy loam to gravelly sand. Corn, wheat, alfalfa, and bromegrass are the principal crops, but yields are below average for the county. The major management problems are increasing fertility and controlling erosion. (Capability unit IVe-3; Sandy windbreak group)

Ortello complex, 12 to 17 percent slopes, eroded (OrE2).—This strongly sloping complex has had 50 percent or more of the original surface layer removed by erosion in a larger area than has Ortello complex, 6 to 12 percent slopes, eroded. Management is more difficult on Ortello complex, 12 to 17 percent slopes, eroded, because the erosion hazard is greater. Good yields of tame and native grasses, however, can be produced for forage. (Capability unit VIe-3; Sandy windbreak group)

Pawnee Series

The soils in the Pawnee series are deep, dark, and well drained. They developed from clayey glacial material on moderately sloping and strongly sloping uplands in the southwestern part of the county. The Pawnee soils occur with the Adair, Morrill, and Shelby soils on the side slopes of hills and on narrow ridgetops.

The surface layer is very dark brown clay loam or silty clay loam that is 8 to 15 inches thick and has granular structure (fig. 17). It is medium acid, generally low in phosphorus, and deficient in nitrogen. The surface layer grades abruptly to a dark-brown clay subsoil that is very hard when dry and sticky when wet. The subsoil absorbs water slowly and swells to form a compact, dense mass when wet. It contains a small amount of coarse sand and pebbles. The substratum is slightly weathered clay or clay loam till containing many sand grains and pebbles and a few till boulders. In most places the till is leached of lime for a foot or more below the subsoil, but there are

Figure 17.—**Profile of a Pawnee clay loam.**

some concretions of lime carbonate below the leached material.

Erosion is a hazard because of the rapid surface drainage, very slow permeability in the subsoil, and runoff from higher slopes. Areas still in native sod are likely to lose only a little soil, but clean-tilled fields have high losses. Corn, grain sorghum, and wheat are the principal crops. These soils produce good forage of native and tame grasses. Additions of fertilizers and lime are needed in amounts indicated by soil tests. Erosion control practices are a part of good management on these soils.

Pawnee clay loam, 6 to 9 percent slopes, eroded (PwC2).—Most of this soil is cultivated and is subject to further water erosion that may be moderate or severe. Because erosion has thinned the dark-colored surface layer, the lighter colored subsoil is exposed in small areas in fields. (Capability unit IIIe–2; Silty to Clayey windbreak group)

Pawnee clay loam, 9 to 12 percent slopes, eroded (PwD2).—This soil is more strongly sloping than Pawnee clay loam, 6 to 9 percent slopes, eroded, and therefore is more susceptible to erosion. Profitable yields of cultivated crops are more difficult to maintain. (Capability unit IVe–2; Silty to Clayey windbreak group)

Platte Series

This series consists of nearly level, imperfectly drained, loamy soils that developed from silty or sandy alluvium in former channels of the Platte River. Coarse sand and gravel occur below a depth of 10 to 20 inches. Platte soils are not extensive in Saunders County.

The surface layer is black loam or sandy loam 6 to 14 inches thick. The subsoil of brownish loam, sandy loam, or loamy sand is only a few inches thick and grades abruptly to the coarse sand and gravel. Although the water table is below 5 feet in only a few places, these soils are droughty and poorly suited to cultivated crops because the root zone is limited and the moisture-storing capacity is low. Yields of native grass forage are good if rainfall is well distributed through the summer, but in dry summers little or no forage is produced.

Platte loam (0 to 2 percent slopes) (Pt).—This soil is on bottom lands along the Platte River. It produces good yields of forage if rainfall is well distributed, but it is not suited to cultivated crops. (Capability unit IVs–4; Shallow windbreak group)

Rauville Series

In the Rauville series are nearly level, poorly drained, silty to clayey soils on bottom lands. These soils are wet throughout the year, but in most areas coarse native grasses grow and are used for hay or pasture. Rushes, cattails, and other marsh plants grow in a few, small, wet areas.

The surface layer is dark-colored silty clay loam or silty clay that extends to a depth of several feet. It contains many partly decomposed stems and leaves of grasses, and there are rusty-brown iron stains along old root channels.

Rauville soils (0 to 2 percent slopes) (Ra).—These soils are so poorly drained that they cannot be cultivated, but the coarse native grasses that grow in most areas can be used for forage. The soils are strongly affected by salts and alkali in some areas but are not affected in others. (Capability unit Vw–6; Wetland windbreak group)

Riverwash (Rw)

Riverwash is made up of sand or sand and gravel that have been recently deposited on the flood plains of the Platte River. It is not suitable for farming. The river frequently floods areas of Riverwash and scours them or changes their size and shape by shifting the deposits. Cocklebur, barnyardgrass, and other annual weeds grow in some areas. Although many areas are bare, a few areas have been stabilized by willow and cottonwood trees. Sediments are continually deposited widely, but scour is limited to the banks. Favorite sites for duck-blinds are some islands of Riverwash in the Platte River and some areas that extend from the banks into the river channel. (Capability unit VIIIw–3; not suitable for a windbreak)

Sarpy Series

Soils of the Sarpy series are deep, very sandy, and well drained or imperfectly drained. They occur on nearly level bottom lands of the Platte River.

The surface layer is very dark grayish-brown loamy fine sand or fine sand 6 to 15 inches thick. The subsoil is dark-gray or dark grayish-brown loamy sand in the upper part and pale-brown fine sand in the lower part. The fine sand is underlain by coarse sand or sand and gravel.

These soils have low water-holding capacity. They tend to be droughty, and wind erosion is a hazard in cultivated areas. Fertility is low. Corn, sorghums, small grains, and alfalfa are grown sucessfully on the soils with a loamy fine sand surface layer, but yields are below average for the county. Good yields of native grasses are produced for forage.

Sarpy fine sand (0 to 2 percent slopes) (Sa).—This droughty soil is best suited to permanent grasses. Unless grazing is controlled, however, the grasses are not dense enough to prevent the wind from shifting the surface. (Capability unit VIe–5; Very Sandy windbreak group)

Sarpy fine sand, hummocky (2Sa).—Except for its surface, this soil is similar to Sarpy fine sand. The wind has worked the surface into low hummocks. Vegetation is sparse and, in most places, consists of sandreedgrass and annual grasses or weeds. Some areas have been cultivated, but others have not. This soil is droughty and best suited to permanent grasses. (Capability unit VIe–5; Very Sandy windbreak group)

Sarpy loamy fine sand (0 to 2 percent slopes) (Sg).—This is a well-drained soil that has a loamy fine sand surface layer and subsoil. If the soil is carefully managed to control wind erosion, cultivated crops can be grown. This soil contains slightly more silt and clay throughout the profile than Sarpy fine sand and is less droughty. Nitrogen and phosphate fertilizers help maintain profitable yields. (Capability unit IIIe–5; Sandy windbreak group)

Sarpy loamy fine sand, loamy substratum (0 to 2 percent slopes) (4Sg).—The surface layer and subsoil of this soil are similar to those in Sarpy loamy fine sand. The subsoil is underlain by a layer consisting of 12 to 24 inches

of dark-colored very fine sandy loam, silt loam, or silty clay loam. Because of this layer and its higher content of silt and clay, this soil has a higher moisture-holding capacity than Sarpy soils without the layer, and crop yields are 10 to 50 percent higher. (Capability unit IIIe–5; Sandy windbreak group)

Sarpy loamy fine sand, imperfectly drained (0 to 2 percent slopes) (2Sg).—This soil is more poorly drained than Sarpy loamy fine sand because its water table is only 3 to 5 feet below the surface. Also, its surface layer is generally darker and thicker. Crop yields are higher if this soil is fertilized and carefully managed. (Capability unit IIIw–5; Moderately Wet windbreak group)

Sharpsburg Series

In the Sharpsburg series are well-drained soils that developed from loess of Peorian age on nearly level to steeply sloping uplands.

The surface layer is very dark brown silty clay loam that has granular structure and is 6 to 16 inches thick. It grades to a dark-brown silty clay loam subsoil. The subsoil has blocky structure and is hard when dry and plastic when wet. The substratum is grayish-brown loess that, in some places, is mottled and stained with yellowish-brown and very dark brown concretions. Neither lime concretions nor free lime occurs (fig. 18).

***Figure 18.*—Profile of a Sharpsburg silty clay loam.**

These are the most productive soils on the uplands in the county. Corn, grain sorghum, wheat, spring small grains, and alfalfa are the principal crops. The surface layer is medium acid. Soil tests indicate that available phosphorus is low or moderately low but that the supply of potassium is adequate. Zinc is deficient in terrace channels, in severely eroded areas, and in areas where the dark-colored surface layer has been removed.

Sharpsburg silty clay loam, 0 to 2 percent slopes (ShA).—This soil occurs on nearly level, well-drained uplands. It is the most extensive soil in Todd Valley and is on the broader ridgetops throughout the county. The surface layer is very dark brown silty clay loam 10 to 16 inches thick. It has granular structure. The soil takes in and retains a large part of the precipitation. The loss of soil through runoff is slight. (Capability unit I–1; Silty to Clayey windbreak group)

Sharpsburg silty clay loam, 2 to 4 percent slopes (ShB).—This soil occurs on rounded ridgetops throughout the county. Its very dark brown surface layer is 8 to 14 inches thick. The soil takes in and retains a large part of the precipitation, but runoff washes away some soil in cultivated areas. (Capability unit IIe–1; Silty to Clayey windbreak group)

Sharpsburg silty clay loam, 4 to 6 percent slopes, eroded (ShC2).—This soil occurs on sloping ridgetops, on slopes below the nearly level, broad ridgetops, and on ridges and side slopes in the old high valleys. The very dark brown surface layer is 6 to 10 inches thick, which is several inches thinner than that in similar soils on milder slopes. The soil takes in and retains a large part of the precipitation, but the runoff during rains of average intensity washes away some soil. Much soil and moisture are lost during the intense rains that occur several times each year. Because the erosion hazard is moderate in cultivated areas, good management should include practices that keep soil and water losses at a minimum. (Capability unit IIIe–1; Silty to Clayey windbreak group)

Sharpsburg silty clay loam, 6 to 12 percent slopes, eroded (ShD2).—This moderately sloping soil is slightly more susceptible to erosion than Sharpsburg silty clay loam, 4 to 6 percent slopes, eroded. Included in mapped areas are small areas of soils similar to Sharpsburg silty clay loam, 6 to 12 percent slopes, severely eroded. (Capability unit IIIe–1; Silty to Clayey windbreak group)

Sharpsburg silty clay loam, 6 to 12 percent slopes, severely eroded (ShD3).—This soil has lost all or nearly all of its original dark-colored surface layer, and in tilled fields many light-colored areas show where the subsoil is exposed. Because the soil takes in water slowly, runoff is rapid during rains of high intensity. The erosion hazard is severe in cultivated fields (fig. 19). Crop yields are much lower than on Sharpsburg silty clay loam, 6 to 12 percent slopes, eroded. (Capability unit IIIe–8; Silty to Clayey windbreak group)

Sharpsburg silty clay loam, 12 to 17 percent slopes, eroded (ShE2).—This soil borders the deeply entrenched major drainageways and is adjacent to drainageways in the strongly sloping uplands. It has a thinner surface layer and subsoil than the Sharpsburg soils on milder slopes. Because slopes are steep, runoff is rapid and much precipitation and soil are lost. Small gullies are numerous in cultivated fields but are few in grassed areas. Growing clean-tilled crops increases the erosion hazard. Crop yields are lower than on Sharpsburg soils having milder

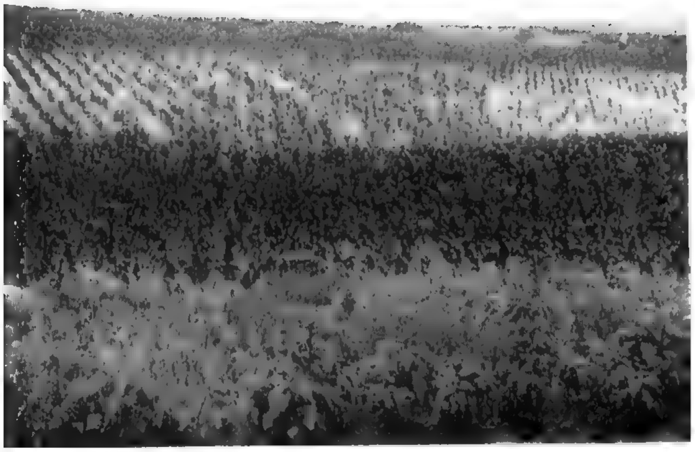

Figure 19.—**Band of stunted crops on a severely eroded Sharpsburg soil contrasts with better crops on each side of band.**

slopes, chiefly because it is more difficult to maintain high fertility where soil losses are high. (Capability unit IVe–1; Silty to Clayey windbreak group)

Sharpsburg silty clay loam, 12 to 17 percent slopes, severely eroded (ShE3).—This soil has lost all or nearly all of its original dark-colored surface layer, and in tilled fields many light-colored areas show where the subsoil is exposed. Growing of clean-tilled crops increases the erosion hazard. Yields of cultivated crops are lower than on Sharpsburg silty clay loam, 12 to 17 percent slopes, eroded. Water frequently damages seedlings by washing the soil from the roots. High yields of perennial grasses are produced for forage. (Capability unit IVe–8; Silty to Clayey windbreak group)

Sharpsburg and Wymore Soils

Sharpsburg soils and Wymore soils occur together in the southwestern part of the county and are so intermingled that it is not practical to show them separately on the map. The subsoil in Wymore soils is silty clay, and that in Sharpsburg soils is silty clay loam. Wymore soils are slightly less permeable than Sharpsburg soils and lose a greater part of the precipitation through runoff. Consequently, Wymore soils are more susceptible to erosion. Yields of corn and alfalfa are 5 to 10 percent lower on Wymore soils than on Sharpsburg soils, but yields of wheat and spring small grains are about the same. Management practices are similar.

Sharpsburg and Wymore silty clay loams, 2 to 4 percent slopes (SWB).—These soils occur on rounded ridgetops. Their very dark brown surface layer is 8 to 12 inches thick. These soils take in and retain a large part of the precipitation, but some moisture and soil are lost in cultivated areas. (Capability unit IIe-1; Silty to Clayey windbreak group)

Sharpsburg and Wymore silty clay loams, 4 to 6 percent slopes, eroded (SWC2).—These soils occur on sloping ridgetops and on slopes below the nearly level, broad ridgetops. The very dark brown surface layer is 6 to 10 inches thick. It is several inches thinner than the surface layer in similar soils on milder slopes. These soils take in and retain a large part of the precipitation, but rains of average intensity cause some runoff and soil loss. The loss of water and soil is appreciable during the intense rains that occur several times each year. Because the hazard of erosion is moderate in cultivated fields, good management is needed that provides practices to keep soil and water losses at a minimum. (Capability unit IIIe–1; Silty to Clayey windbreak group)

Sharpsburg and Wymore silty clay loams, 6 to 12 percent slopes, eroded (SWD2).—These soils are slightly more susceptible to erosion than similar Sharpsburg and Wymore soils on milder slopes. Small areas of Geary, Adair, Pawnee, and Shelby soils are included with these soils. (Capability unit IIIe–1; Silty to Clayey windbreak group)

Sharpsburg and Wymore silty clay loams, 6 to 12 percent slopes, severely eroded (SWD3).—These soils have lost all or nearly all of the original dark-colored surface layer, and in tilled fields many light-colored areas of exposed subsoil can be seen. Small areas of Geary, Adair, Pawnee, Shelby, and Malcolm soils are included with this soil. The erosion hazard is severe in cultivated fields. Crop yields are appreciably lower than on less eroded Sharpsburg and Wymore soils on comparable slopes. (Capability unit IIIe–8; Silty to Clayey windbreak group)

Sharpsburg and Wymore silty clay loams, 12 to 17 percent slopes, eroded (SWE2).—These soils border deeply entrenched major drainageways and are adjacent to drainageways in the strongly sloping uplands. The surface layer and subsoil are not as thick as are those in similar soils on milder slopes. Because slopes are steep, runoff is rapid and further erosion is likely. Small gullies are numerous in cultivated areas but are few in grassed areas. Crop yields are lower than those on similar Sharpsburg and Wymore soils with milder slopes. Because soil losses are high, maintaining fertility is difficult. (Capability unit IVe–1; Silty to Clayey windbreak group)

Sharpsburg and Wymore silty clay loams, 12 to 17 percent slopes, severely eroded (SWE3).—These soils have lost all or nearly all of the original dark-colored surface layer, and in tilled fields many light-colored areas show where the subsoil is exposed. Growing of clean-tilled crops greatly increases the erosion hazard. Yields of cultivated crops are lower than on less eroded Sharpsburg and Wymore soils that have comparable slopes. Seedlings are frequently damaged when water washes the soil from their roots. Small gullies are numerous in cultivated areas but are few in grassed areas. High yields of perennial grasses can be produced for forage, and many areas have been seeded to bromegrass, which is used for pasture or for seed. (Capability unit IVe–8; Silty to Clayey windbreak group)

Shelby Series

The Shelby series consists of soils that have a clay loam subsoil. These soils developed in glacial material on moderately sloping and strongly sloping uplands. Most areas are in the southwestern part of the county, but small areas are found elsewhere. Shelby soils are less clayey in the subsoil than Pawnee soils and are leached of lime to a greater depth than Burchard soils. Shelby

soils are mapped only in complex with Burchard soils in Saunders County.

The surface layer is very dark brown clay loam that has granular structure and is 6 to 16 inches thick (fig. 20). In many places it contains a few cobbles and small stones, and commonly there are grains of coarse sand. The subsoil is clay loam that is dark brown in the upper part and dark yellowish brown in the lower. It grades gradually to the substratum that is mottled and stained with yellowish brown, strong brown, black, and dark brown. The substratum is till or sandy drift in most places but is sand in a few.

These soils are medium acid. Corn and small grains respond well to applications of nitrogen and phosphate fertilizers, and alfalfa to phosphate fertilizer. The supply of potassium is adequate, but zinc is often deficient in severely eroded areas and in cultivated fields.

Shelby and Burchard clay loams, 6 to 12 percent slopes (SBD).—The surface layer of these soils is dark-colored, friable clay loam 12 to 16 inches thick. Most areas are in native grass, but some are cultivated, and each year the cultivated acreage increases. Areas remaining in native grass occur with soils that are too steep for cultivation or are otherwise unsuitable. (Capability unit IVe–1; Silty to Clayey windbreak group)

Shelby and Burchard clay loams, 6 to 12 percent slopes, eroded (SBD2).—These soils occur on moderately sloping and strongly sloping side slopes. Their surface layer is dark colored, friable, and 8 to 12 inches thick. Most areas are cultivated or have been cultivated. Crop yields are high if enough fertilizer is added and erosion is controlled.

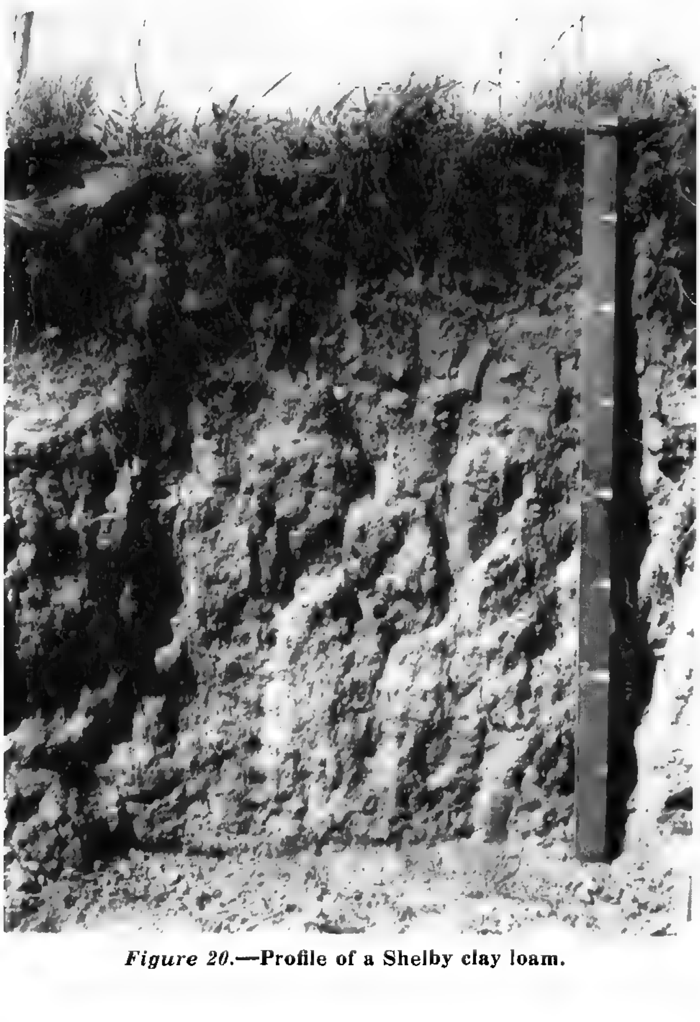

Figure 20.—**Profile of a Shelby clay loam.**

These soils are medium acid. Soil tests indicate that the content of phosphorus is medium to low. Except for the first year after a legume is grown, nitrogen fertilizer is needed. The principal crops are corn and wheat. Red clover may be grown in fields that have not been limed, but lime is needed for high yields of alfalfa. Sweetclover is grown as a green-manure crop. Spring small grains are planted, but yields are generally low. (Capability unit IVe-1; Silty to Clayey windbreak group)

Shelby and Burchard clay loams, 6 to 12 percent slopes, severely eroded (SBD3).—Because of severe erosion, these soils have a thinner surface layer than Shelby and Burchard clay loams, 6 to 12 percent slopes, eroded, and in many areas all or nearly all of the original surface layer has been removed. The plow layer is material that was formerly in the subsoil and is less friable than the original surface layer. This material is difficult to till because it is plastic when wet and hard when dry. Precipitation is absorbed slowly, and runoff during heavy rains frequently washes out seeds or young plants. Fertility is low. (Capability unit IVe–8; Silty to Clayey windbreak group)

Steinauer Series

In this series are well-drained soils that developed in calcareous till on steep and very steep uplands (fig. 21).

The surface layer is dark colored, 6 to 12 inches thick, and calcareous in many places. Soil development is weak, and the surface layer grades gradually to the slightly weathered, gray and yellowish-brown calcareous till.

Although the surface layer is friable and absorbs water readily, tilled crops are not suitable because slopes are steep and the unweathered till is near the surface. With little management, however, these soils produce good yields of grass for forage year after year. Because plowed areas soon lose their friable surface layer, erosion is a problem in cultivated areas and a cover of vegetation is difficult to reestablish.

Steinauer clay loam, 12 to 30 percent slopes (StE).—Most of this soil is in native plants, and some has been plowed and is farmed with adjacent, more productive soils. Some areas are idle because of their low productivity, and others have been replanted to grass or trees. Grazing is the main use, but a few areas have a thick stand of trees of little commercial value. (Capability unit VIe–1; Silty to Clayey windbreak group)

Volin Series

The soils of the Volin series formed in loamy, water-deposited sediments, mainly on the nearly level flood plain of the Platte River. They are moderately well drained and occur in higher, better drained areas than the associated Leshara soils. They have a finer textured, more coherent subsoil than the Cass soils.

The friable surface layer is dark-gray very fine sandy loam, loam, or silt loam that has granular structure and is 10 to 16 inches thick. The subsoil is stratified and ranges from light brownish gray to dark grayish brown in color and from silt loam to very fine sandy loam in texture. It is granular and friable. This soil is generally noncal-

careous to a depth of 30 or 40 inches and is free of mottles. The upper substratum is lighter colored than the subsoil but is similar in texture. In some places there are thin lenses of sand or clay, as well as a thin, dark-colored horizon that is the surface layer of a buried soil. Coarse sand or mixed sand and gravel occur at a depth below 3 to 6 feet.

Volin silt loam (0 to 2 percent slopes) (Vo).—This is one of the most productive soils in the county. Most of it is cultivated and produces high yields. Natural fertility and water-holding capacity are high. After intense rains, this soil is occasionally flooded by water from upland drains, but excess water is soon removed because surface drainage is good and the soil is moderately permeable.

Maintaining fertility is a major problem in managing this soil. Yields of suitable crops are high if tillage is good and fertilizer is added according to the needs indicated by soil tests. Irrigation helps to insure high yields in years when the moisture supply is low. Although irrigation is feasible, extension of irrigation has been slow on this soil. (Capability unit I-1; Silty to Clayey windbreak group)

Wann Series

The Wann series consists of moderately deep or deep, imperfectly drained, nearly level soils in sandy alluvium, mainly on the flood plain of the Platte River. These soils developed in material similar to that of the Cass soils, but Wann soils are lower and are not so well drained.

These soils have a dark-gray fine sandy loam surface layer 6 to 16 inches thick. The subsoil is grayish-brown fine sandy loam with weak subangular blocky structure. It grades to lighter colored loamy sand and to sand or sand and gravel. The soils are generally slightly calcareous in the surface layer and strongly calcareous in the subsoil.

Wetness often delays planting in spring, but the moderately deep soils are somewhat droughty in dry summers. Although alfalfa is grown successfully on the drier areas, a stand is difficult to keep in the swales and other low areas because the water table restricts the root zone.

Wann soils are low in phosphorus. Starter fertilizers containing nitrogen benefit crops in years when the soils are wet at planting time. The response to fertilizer, however, is not so good as it is on soils of uplands or on Cass, Volin, and other better drained soils on bottom lands.

Wann fine sandy loam, moderately deep (Wb).—In this imperfectly drained soil, fine sandy loam extends from the surface to a depth of 20 to 36 inches and is underlain by a substratum of coarse sand and gravel. Moisture is absorbed quickly, and it moves downward through the soil. A water table near the surface keeps the soil wet in winter and spring, but it recedes in summer to a depth of 4 to 6 feet, and the crops soon use the available moisture and are damaged by drought. Forage sorghum, rye, and corn are the principal crops and produce well if rainfall is above normal in summer. Yields of native grass forage are good. (Capability unit IIIw-6; Moderately Wet windbreak group)

Wann fine sandy loam, deep (0 to 2 percent slopes) (3Wb).—The fine sandy loam in this soil extends deeper than that in Wann fine sandy loam, moderately deep, but in other respects the two soils are similar. The fine sandy loam extends to a depth of 36 inches or more.

Figure 21.—**Profile of a Steinauer clay loam.**

Corn, grain sorghum, and wheat are the principal crops. In dry summers yields of corn are higher on this soil than they are on the moderately deep one because the water table provides subirrigation. (Capability unit IIw-6; Moderately Wet windbreak group)

Wann fine sandy loam, alkali (0 to 2 percent slopes) (2Wb). The fine sandy loam surface layer of this imperfectly drained soil is underlain by layers of sandy loam, very fine sandy loam, and loamy fine sand. Because the water table does not fluctuate much, salts accumulate more in this soil than they do in Wann soils that have a more fluctuating water table. Many areas called slick spots have had soil structure weakened by alkali salts. The surface is crusted with white salt during winter and spring.

About 70 percent of this soil is moderately alkali, and the rest is unaffected by alkali salts or is only moderately affected. Tillage is difficult because of the salts. It is not feasible to apply fertilizer to increase the low supply of plant nutrients, because the fertilizer soon mixes with the salts and cannot be used by the plants. Yields of rye, barley, and forage sorghum, the principal crops, are low. Yields of alkali-tolerant grasses and wheatgrasses

are good. Most areas in native plants have been overgrazed, are weedy, and require reseeding. (Capability unit VIs–1; Moderately Saline-Alkali windbreak group)

Wymore Series

Soils of the Wymore series are well drained and nearly level to steep. They developed on uplands in loess of Peorian age.

The surface layer is very dark brown silty clay loam that has granular structure and is 6 to 16 inches thick. The subsoil is silty clay that generally is very dark grayish brown in the upper part and dark grayish brown in the lower part. It is black and hard when dry and plastic when wet. The substratum is grayish-brown silty clay loam with many, yellowish-brown, reddish-brown, and very dark brown mottles and stains. These soils are medium acid in the surface layer, medium acid to slightly acid in the subsoil, and neutral in the substratum.

These soils are productive. Their principal crops are corn, grain sorghum, wheat, spring small grains, and alfalfa. Soil tests indicate that the content of available phosphorus is low or very low. The supply of potassium is generally adequate. Zinc is commonly deficient in terrace channels, in severely eroded areas, and in other areas where the dark-colored surface layer has been removed. The Wymore soils are of minor extent in Saunders County and are mapped with the Sharpsburg soils.

Use and Management of the Soils

This section discusses the use and management of soils as cropland, as grassland, for tame pasture, and for wildlife. It also describes soil characteristics that affect soils used in engineering.

According to the Conservation Needs Inventory, about 84 percent of the land in Saunders County was used for cultivated crops in 1958. Of the remaining 16 percent, 7 percent was in pasture, 2 percent in woodland, 2 percent in other agricultural land (that used for farm buildings, idle land, and the like), and 5 percent in nonagricultural land.

The Conservation Needs Inventory projected the trend of land use from 1958 to 1975 as follows:

Use	*Acres in 1958*	*Acres in 1975*
Cropland	406, 200	401, 900
Grassland	32, 400	35, 800
Woodland	9, 400	9, 100
Other agricultural land	11, 700	11, 200
Nonagricultural land	24, 140	25, 840

The cropland is expected to decrease 4,300 acres between 1958 and 1975. This decrease is accounted for by a predicted conversion of 3,700 acres from cropland to grassland, 900 acres from cropland to nonagricultural land, and 300 acres from woodland to cropland.

Grassland is predicted to increase 3,400 acres. About 3,700 acres of cropland is expected to be converted to grassland, but 300 acres of grassland will be put into nonagricultural use.

The 9,400 acres of woodland is expected to be reduced to 9,100 because 300 acres will be converted to cropland.

Other agricultural land, which includes farmsteads and idle land, is predicted to decrease from 11,700 acres in 1958 to 11,200 acres in 1975, a decrease of 500 acres. This acreage is expected to go into nonagricultural use.

If these conversions from one kind of use to others take place, the total agricultural land, which was 459,700 acres in 1958, will be 458,000 acres in 1975.

About 70,000 acres of soils not suited to crops (classes V to VII) is currently cropped, but the decrease in cropland by 1975 that was predicted in the Conservation Needs Inventory amounts to only 4,300 acres. A major problem of land use in the county is converting to other use soils that are cultivated but are not suited to crops.

Most of the soils in Saunders County have been well managed and remain fertile, easily tilled, and highly productive. Erosion has been and is the greatest hazard in cultivated areas, particularly during intense rainstorms. These storms are most frequent in May and June when the ground cover is at a minimum. Management that is used successfully in reducing erosion includes the use of contour cultivation, terraces, grassed waterways, crop residue, and field-border seedings. Maintaining fertility was difficult for many years, but commercial fertilizers are now widely used. The organic-matter content declined rapidly after the native sod was broken, and it continued to decline, though slowly, under average management. This trend was slowed, however, and the surface soil was darkened by the use of fertilizers, crop residues, erosion control practices, and other good management. The soils have become more friable, and they take in water more readily and are not so easily compacted or so easily eroded during rainstorms. Many farmers use large additions of fertilizer as a substitute for agronomic and mechanical erosion control practices, but these farmers are only partly successful because more than a supply of plant nutrients is needed for good management.

About 3 percent of the cropland in Saunders County is irrigated. The principal irrigated areas are in Todd Valley and in the valley of the Platte River. Because the soils in these areas are suitable for irrigation, and ample ground water is available, the irrigated acreage can be increased. Scattered areas throughout the uplands are also suitable for irrigation, but ground water is generally lacking.

Excellent for irrigation are the nearly level Sharpsburg soils in Todd Valley and the Volin soils on the bottom lands of the Platte River. These soils are deep and well drained. They absorb and store water readily and release it readily to plants. The moderately sandy Cass soils also take in, store, and release water readily, but they have a low water-holding capacity. The Butler soil has a heavy claypan and takes in water slowly.

Management of Cropland

Cultivated fields in Saunders County are managed for the purpose of conserving moisture, controlling erosion, and maintaining fertility, organic matter, and good tilth. To accomplish these purposes, farmers cultivate on the contour, use suitable cropping systems, apply fertilizers, grass the waterways, and use other practices. Most of the practices used accomplish more than one purpose.

Contour cultivation

In contour cultivation, tilling and planting are performed along lines that are about level and are parallel to each other. Consequently, the furrows, ridges, and wheel tracks are also nearly level. Because some of the rain is held in the furrows by the ridges, more water

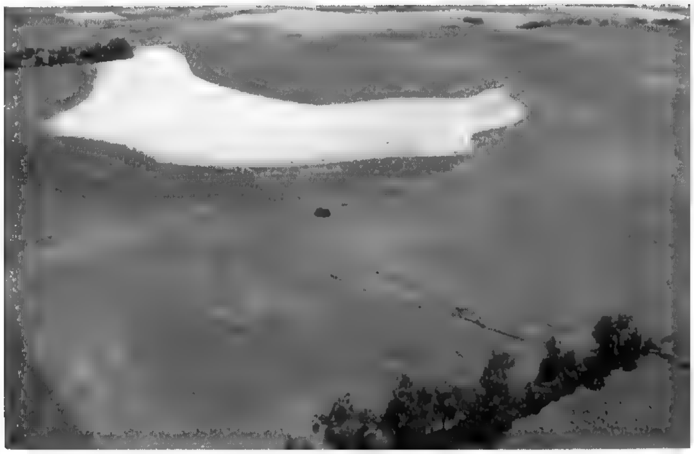

Figure 22.—**Contour cultivation, aided by terraces and grassed waterways, helps reduce loss of water and soil.**

is absorbed by the soil than in fields not cultivated on the contour, and runoff and erosion are reduced. Also, more water is available for crops. Contour cultivation is most effective when it is used with other conservation practices, such as managing residue, building terraces, and grassing the waterways (fig. 22).

Cropping system

A cropping system is a sequence of crops grown in an area for a specified period so that yields are good, the soil is kept in good physical condition and is protected from erosion, and weeds, insects, and plant diseases are controlled.

A good cropping system includes grasses and legumes that produce a large amount of residue. If grasses or other nonlegumes are grown, additions of a nitrogen fertilizer are needed to aid in decomposing the residue of the preceding crop and in preventing a nitrogen deficiency in the succeeding crop.

Legumes should be selected according to the kind of soil. Red clover and lespedeza are tolerant of acid soils, but sweetclover and alfalfa grow best on soils that are nearly neutral or slightly alkaline.

An example of a suitable cropping system for soils on uplands is 2 years of corn or grain sorghum, 1 year of oats, and 1 year of red clover. However, the number of consecutive years that the row crops can be grown and the length of time a legume is grown will depend on the need for erosion control. Erosion is reduced on steep slopes if row crops are not grown or are grown for only 1 year, if the small grain is grown for 1 year, and if a mixture of bromegrass and alfalfa is grown for 2 to 4 years. On the other hand, level bottom land can be kept in good physical condition even if it is planted to corn for 10 consecutive years or longer. Only infrequently are small grains and legumes needed on bottom land.

The cropping system also has to fulfill the needs and desires of the farmer for an economic return.

Fertilizer

Fertilizer is used to maintain a balanced supply of plant nutrients. Yields can be increased on most soils in the county by adding farm manure, chemical fertilizers, or a combination of these. Kinds and amounts of fertilizer should be added as indicated by the results of soil tests or according to information furnished by the Nebraska Agricultural Experiment Station.

Grassed waterways

Grassed waterways are natural drainageways that are protected by grass. In Saunders County nearly all natural drainageways on mild slopes have been plowed and planted to cultivated crops. The cover of protective grass has been removed, and ditches and gullies have formed. Except in very steep drains and in some gullies, the waterways can be seeded to suitable grasses. Before this seeding, however, the waterways should be smoothed and shaped so that the water covers the width of the drain instead of flowing in a narrow channel (fig. 23). If grassed waterways are fertilized and maintained, they control erosion, produce hay or grass seed, and furnish cover for upland game birds.

Minimum tillage

Soils used for cultivated crops are tilled to prepare a seedbed, to control weeds, and to provide a favorable environment for plants. Excessive tillage, however, breaks down soil structure. The soil tends to puddle if it is wet and to crust when it dries. It takes in less water and air and stores less moisture for use by plants. The number of operations performed in preparing the seedbed, in planting, and in harvesting may vary greatly under different management. Management that emphasizes minimum tillage greatly reduces the number of operations performed in producing the crop. In minimum tillage, the plow and disk-harrow are seldom used but are replaced by a tool that stirs the soil and plants the seed without turning under the litter from the preceding crop. Instead of tilling to control weeds, fields are sprayed before the weeds emerge. Reducing the number of operations reduces the cost of machinery, labor, and fuel, and there is less compaction. The crop residues left on the surface reduce wind and water erosion.

Figure 23.—**Newly shaped and seeded waterway. The dikes protect the waterway and the new grass seedings from washing and are removed after the grass is established.**

Use of crop residues

Crop residues left after harvesting protect the soils from erosion, increase the intake of moisture, and add organic matter that improves soil tilth or helps to maintain the supply of plant nutrients.

Removing crop residues by excessive grazing, by burning, or by plowing them under exposes the surface to soil blowing and water erosion (fig. 24). Under good management, crop residues are left on the surface of the soils not protected by a growing crop. The method of using crop residues depends on the kind of soil, the cropping system, the amount of residues available, and the preference of the farmer. If stubble-mulch tillage is used, crop residues remain on the surface and protect the soils throughout the year. Other tillage methods reduce the length of time that the soil is protected. In all tillage practices now used in the county, crop residues remain on the soil during the winter, except when the soil is plowed in fall to prepare it for a spring-seeded crop.

***Figure 24.*—Crop residues left on the surface to protect the soil from washing and blowing.**

Terraces

Terraces are embankments or ridges that are constructed across slopes to intercept water that is not taken into the soil. Excess water is held in terraces until it soaks into the soil, or the water flows into prepared waterways that carry it from fields without carrying soil with it. Because much precipitation occurs during intense storms, terraces are needed on sloping fields to supplement other conservation structures or practices. Grassed waterways are necessary in a terrace system because they provide the safe outlets for the surplus water. In most places, it is advisable to establish grassed waterways before terracing.

Capability Groups of Soils

The capability classification is a grouping of soils that shows, in a general way, how suitable the soils are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soils are grouped at three evels, the capability class, subclass, and unit. Eight capability classes are in the broadest grouping and are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be as many as four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil will interfere with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in some parts of the United States, but not in Saunders County, indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the susceptibility of the soils to erosion is little or none, but other limitations limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, which are groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally identified by numbers assigned locally, for example, IIe-1 or IIIe-2. These numbers are not consecutive in Saunders County, because not all capability units used in Nebraska occur in Saunders County.

Soils are placed in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

The eight classes in the capability system, and the subclasses and units in this county, are described in the list that follows.

Class I. Soils that have few limitations that restrict their use.

Capability unit I-1.—Deep, nearly level soils that have a silt loam or silty clay loam surface soil and a subsoil with moderately slow permeability.

Class II. Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.

Subclass IIe. Soils subject to moderate erosion if they are not protected.

Capability unit IIe-1.—Deep, gently sloping soils that have a silty clay loam surface soil and a subsoil with moderately slow permeability.

Capability unit IIe-3.—Deep and moderately deep soils that are on nearly level bottom lands and have a fine sandy loam surface soil and a subsoil with moderate to moderately rapid permeability.

Subclass IIw. Soils that have moderate limitations because of excess water.

Capability unit IIw-3.—Deep, nearly level soils that are on occasionally flooded bottom lands and have a silt loam or silty clay loam surface soil and a subsoil with moderate to moderately slow permeability.

Capability unit IIw-4.—Deep, moderately wet soils that are on nearly level bottom lands and have a silt loam or silty clay loam surface soil and a subsoil with moderate to moderately slow permeability.

Capability unit IIw-6.—Deep, moderately wet soil that is on nearly level bottom lands and has a fine sandy loam surface soil and a subsoil with moderately rapid permeability.

Subclass IIs. Soils that have moderate limitations of moisture capacity or tilth.

Capability unit IIs-2.—Deep soil that is on flats and in slight depressions and has a silty clay loam surface soil and a slowly permeable subsoil.

Class III. Soils that have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.

Capability unit IIIe-1.—Deep, moderately sloping soils that are on uplands and have a silt loam or silty clay loam surface soil and a subsoil with moderate to moderately slow permeability.

Capability unit IIIe-2.—Deep, moderately sloping soils that are on sloping uplands and have a clay loam surface soil and a slowly permeable subsoil.

Capability unit IIIe-3.—Deep, loamy soil on moderately sloping foot slopes.

Capability unit IIIe-5.—Deep, well-drained, sandy soils on nearly level and hummocky bottom lands.

Capability unit IIIe-8.—Deep, eroded and severely eroded soils on moderately sloping uplands.

Subclass IIIw. Soils that have severe limitations because of excess water.

Capability unit IIIw-1.—Deep, clayey soil on imperfectly drained bottom lands that are seldom flooded.

Capability unit IIIw-2.—Deep soil that has a slowly permeable subsoil and is in upland depressions subject to ponding.

Capability unit IIIw-5.—Deep, sandy soil on moderately wet bottom lands of the Platte River.

Capability unit IIIw-6.—Moderately deep, imperfectly drained soil that is on bottom lands and has a fine sandy loam surface soil, a subsoil with moderately rapid permeability, and underlying material with very rapid permeability.

Subclass IIIs. Soils that have severe limitations of salinity or alkalinity.

Capability unit IIIs-1.—Deep, moderately wet, saline and alkali soil that has a silty clay loam surface soil and a subsoil with moderately slow to slow permeability.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe. Soils subject to very severe erosion if they are cultivated and not protected.

Capability unit IVe-1.—Deep, strongly sloping soils that are on uplands and have a silt loam to silty clay loam surface soil and a subsoil with moderate to moderately slow permeability.

Capability unit IVe-2.—Deep, moderately sloping soils that are on uplands and have a silty clay loam or clay loam surface soil and a slowly permeable, clayey subsoil.

Capability unit IVe-3.—Deep, moderately to rapidly permeable, loamy soils on sloping uplands.

Capability unit IVe-8.—Deep, moderately sloping to strongly sloping soils that are on uplands and have an eroded silt loam to silty clay loam surface soil and a subsoil with moderate to moderately slow permeability.

Subclass IVw. Soils that have very severe limtations for cultivation because of excess water.

Capability unit IVw-2.—Deep soil that has a slowly permeable subsoil and is in ponded depressions on the uplands.

Subclass IVs. Soils that have very severe limitations of low moisture capacity or other soil features.

Capability unit IVs-4.—Shallow soil with a loam surface soil that is underlain by sand and gravel.

Class V. Soils not likely to erode that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass Vw. Soils too wet for cultivation; drainage or protection not feasible.

Capability unit Vw-6.—Wet soils on nearly level bottom lands that have a water table at or near the surface most of the time.

Class VI. Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass VIe. Soils severely limited, chiefly by risk of erosion, if protective cover is not maintained.

Capability unit VIe-1.—Deep, strongly sloping soils that have a silt loam or clay loam surface soil and a subsoil with moderate to moderately slow permeability.

Capability unit VIe-2.—Deep soils that are on moderately sloping uplands and have a severely eroded clay surface soil and a slowly permeable subsoil.

Capability unit VIe-3.—Deep soils that are on strongly sloping breaks and have a fine sandy loam surface soil and a subsoil and underlying

material with moderately rapid to rapid permeability.

Capability unit VIe–5.—Fine sands on bottom land cut by many channels.

Capability unit VIe–8.—Deep, strongly sloping to steep soils that have a thin or severely eroded silt loam or clay loam surface soil and a subsoil with moderate to moderately slow permeability.

Subclass VIw. Soils severely limited by excess water and generally unsuitable for cultivation.

Capability unit VIw–1.—Deep, silty land type on frequently flooded bottom lands along upland drains.

Capability unit VIw–5.—Light-colored, sandy soils on wet bottom lands of the Platte River.

Subclass VIs. Soils generally unsuitable for cultivation and limited for other uses by moisture capacity, salinity, or alkalinity.

Capability unit VIs–1.—Strongly saline or alkali soils on moderately wet bottom lands.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation, without major reclamation, and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIe. Soils very severely limited, chiefly by risk of erosion, if protective cover is not maintained.

Capability unit VIIe–1.—Steep and very steep, dissected land that has deep, active gullies.

Subclass VIIs. Soils very severely limited by moisture capacity or other soil features.

Capability unit VIIs–1.—Spoil banks along ditches and sand waste around gravel pits.

Class VIII. Soils and land types that have limitations that, without major reclamation, preclude their use for commercial production of plants and restrict their use to recreation, wildlife, water supply, or esthetic purposes.

Subclass VIIIw. Extremely wet or marshy land.

Capability unit VIIIw–3.—Riverwash.

Management of soils by capability units

In the following pages, management of soils in each capability unit is discussed. Important general characteristics of the soils in each capabilty unit are given, and the soils in the unit are listed. Then suitable uses for soils of the group and suggestions for their effective management are given.

CAPABILITY UNIT I-1

The soils in this unit are deep and nearly level. They have a silt loam or silty clay loam surface soil and a subsoil with moderately slow permeability. The soils are—

Muir silty clay loam.
Sharpsburg silty clay loam, 0 to 2 percent slopes.
Volin silt loam.

These soils are fertile, easily tilled, and well suited to cultivated crops. Whether irrigated or not, they are the most productive soils in the county. Most extensively grown are corn, wheat, oats, sorghums, soybeans, legumes, and grasses. Continued high yields are obtained by using management that maintains good tilth, returns crop residues to the soil, and provides an abundant supply of plant nutrients. Manure, fertilizers, and legumes are used to maintain fertility.

The type of farm has much to do with the selection of crops, the crop sequence used, and the choice of amendments. On cash-grain farms commercial fertilizers are applied to replace the plant nutrients removed by crops. On grain-livestock farms nutrients are replaced by adding manure and growing legumes and by supplementing these with fertilizers. To correct soil acidity, agricultural limestone should be applied in amounts indicated by soil tests. Soil tests are also effective in determining nutrient deficiencies and in indicating the amendments needed to correct these deficiencies.

Under efficient management, fertility is kept at a high level and the soils can be used intensively. Corn, soybeans, wheat, and grain sorghum are the main crops. Spring-seeded small grains, legumes, and grasses may be included in the crop sequence, but on most farms these crops are not profitable, and they decrease the efficiency of the farm.

Grassed waterways are needed to conduct runoff across these soils. Diversion ditches may be required to prevent damage by runoff from higher areas. Grassing the turnrows and field roads helps to control weeds along field borders. Plowing before planting is a general practice. Stubble mulching and minimum tillage should be considered, because they increase infiltration and reduce tillage. For maximum yields, effective control of weeds and insects is necessary, as well as timely tilling, seeding, and harvesting.

Crops on these soils respond favorably to irrigation (fig. 25). Most of the small irrigated acreage in the county consists of the soils in this unit. Corn, soybeans, and grain sorghum are the principal irrigated crops. Under dryland or irrigated management, planting and harvesting operations are similar. Smoothing is needed on most fields, but this operation may expose the subsoil and, in a few places, the loess parent material. Large additions of manure and fertilizer aid in restoring smoothed areas to full production. Irrigation water, like fertilizer, is expensive, and high yields must be obtained to justify the added cost. The profit resulting from irrigation is determined by efficiency in the use of water, fertilizer,

Figure 25.—Irrigated corn on Sharpsburg silty clay loam, 0 to 2 percent slopes.

and labor and machinery, by the selection of the crops, and by the timing of the various farming operations.

CAPABILITY UNIT IIe-1

In this unit are gently sloping, deep soils that have a silty clay loam surface soil and a subsoil with moderately slow permeability. The soils are—

Judson silty clay loam, 2 to 6 percent slopes.
Sharpsburg silty clay loam, 2 to 4 percent slopes.
Sharpsburg and Wymore silty clay loams, 2 to 4 percent slopes.

These soils are fertile, easily tilled, and well suited to cultivated crops. Most extensively grown are corn, wheat, oats, sorghums, legumes, and grasses. These soils take in and store water readily and release it readily to plants. The hazard of water erosion is slight to moderate. Continued high yields of crops are insured by using management that maintains good tilth, returns crop residues to the soil, provides an abundant supply of plant nutrients, and lessens the erosion hazard.

Manure, fertilizers, and legumes are used to maintain an abundant supply of plant nutrients. Soil testing helps to determine nutrient deficiencies and indicates efficient use of soil amendments to correct these deficiencies. The type of farm has much to do with the selection of crops, the crop sequence, and the soil amendments. On cash-grain farms commercial fertilizers are heavily applied to replace the plant nutrients removed by crops. On grain-livestock farms the nutrients are replaced by adding manure and growing legumes and by supplementing these with fertilizers. To correct acidity, agricultural limestone should be used in amounts indicated by soil tests.

Maintaining good tilth on these soils requires practices such as (1) returning organic residues to the soil; (2) varying the depth of plowing to prevent compaction of the soil immediately below the furrow slice; (3) avoiding tillage when the soil is too wet or too dry; and (4) avoiding unnecessary compaction by farm animals and machinery. Farmers use many practices to maintain good tilth, and they vary these practices according to the condition of the soil and the results they wish to obtain. For example, a farmer may plow a compacted field in fall to loosen the soil and allow it to aggregate during the winter. The skill of a farmer is reflected by the combination of practices he uses to obtain good tilth.

Management practices that lessen the erosion hazard supplement other good management practices. Suitable for all areas of these soils are contour cultivation, grassing the waterways, and tillage that keeps crop residues on the surface. In some areas terracing and stripcropping may also be used.

Many farmsteads are located on areas of these soils. The soils are well suited to plantings for windbreaks and to garden crops. Wet basements are not a problem, because the loess parent material is permeable and the ground water is many feet below the surface. In addition, the loess offers good support for foundations of buildings of the size generally found on farms.

CAPABILITY UNIT IIe-3

The soils in this unit are on nearly level bottom lands and are deep and moderately deep. They have a fine sandy loam surface soil and a subsoil with moderate to moderately rapid permeability. The soils are—

Cass fine sandy loam, moderately deep.
Cass fine sandy loam, deep.

These soils are fertile, easily tilled, and well suited to cultivated crops. Corn, oats, sorghums, soybeans, and alfalfa are most frequently grown. The soils take in water readily and release it readily to plants, but the soils that have a sandy clay loam subsoil do not store so much water as those with a finer textured subsoil. The moderately deep soil is somewhat droughty. Both soils are susceptible to wind erosion because their surface layer is sandy. Continued good yields can be obtained by using practices that maintain good tilth, insure an adequate supply of organic matter, provide a supply of plant nutrients that is in balance with the moisture supply, and control shifting of the sandy surface soil.

Manure, fertilizers, and legumes are used to maintain an abundant supply of plant nutrients. Soil testing is helpful in determining nutrient deficiencies and in indicating the amount of soil amendments that will correct these deficiencies.

Management practices that lessen the erosion hazard supplement other good management practices. Shifting of the surface soil by wind can be prevented by planting cover crops and by keeping crop residues on the surface. Exposing the surface to the wind can be avoided by preventing excess grazing of crop residues.

CAPABILITY UNIT IIw-3

This unit consists of deep soils that occur on nearly level bottom lands and are subject to occasional flooding. These soils have a silt loam or silty clay loam surface soil and a subsoil with moderate to moderately slow permeability. They are—

Colo silty clay loam.
Hobbs soils.

These soils are fertile, easily tilled, and well suited to cultivated crops. Most extensively grown are corn, wheat, oats, sorghums, soybeans, and grasses. Continued high yields are obtained by using management that maintains good tilth, returns crop residues to the soil, and provides an abundant supply of plant nutrients. Manure and commercial fertilizers are added to maintain the fertility.

The type of farm has much to do with the selection of crops, the crop sequence, and the choice of amendments. On cash-grain farms commercial fertilizers are heavily applied to replace the plant nutrients removed by crops. On grain-livestock farms nutrients are replaced by adding manure and supplementing it with fertilizers. Soil tests are effective in determining nutrient deficiencies and in indicating amendments needed to correct these deficiencies.

If these soils are used intensively, efficient management is needed to keep fertility high. Corn, soybeans, wheat, and grain sorghum are the main crops. Spring-seeded small grains, legumes, and grasses may be included in the crop sequence, but the cash returns from these crops are not so high as those from other crops, and these lower returns reduce profits on most farms.

Grassed waterways are needed to conduct runoff water across these soils. Grassing the turnrows helps to control weeds along field borders. Plowing before planting is a general practice. For maximum yields, effective control of weeds and insects is necessary, as well as timely tilling, seeding, and harvesting.

These soils are occasionally flooded by adjacent streams, but the water drains away or soaks into the soil within a few hours. The damage to crops is seldom severe, but

planting or tilling may be delayed. Light silting damages fences and, over a long period, fills road ditches and drainage ditches. Wheat and alfalfa are damaged more often than corn and sorghums. The floods add to the moisture supply, and the fertile, dark-colored sediments help maintain fertility.

CAPABILITY UNIT IIw-4

In this unit are deep, moderately wet soils on nearly level bottom lands. These soils have a silt loam or silty clay loam surface soil and a subsoil with moderate to moderately slow permeability. They are—

Colo silty clay loam, clayey substratum.
Lamoure silty clay loam.
Leshara silt loam, moderately deep.
Leshara silt loam, deep.
Muck.

These soils are fertile and well suited to cultivated crops. Cultivating and planting are often delayed because surface drains are lacking and the fluctuating water table rises into the root zone during winter and spring. When rainfall is below normal in spring and summer, water from the high water table benefits the crops.

On these soils, the selection of crops is not so wide as on the well-drained soils of the bottom lands. Corn, grain sorghum, and soybeans are the principal crops. Wheat is planted in the fall in years when wetness prevents planting of other crops in the spring. Spring-seeded small grains are seldom grown. Yields of alfalfa vary because in some years the root zone is restricted by a high water table that damages plants.

Maximum yields from these soils are obtained by using management that maintains good tilth, returns crop residues to the soil, provides a balanced supply of plant nutrients, and improves drainage. Manure, fertilizers, and legumes are used to maintain fertility.

The type of farm has much to do with the selection of crops, the crop sequence, and the choice of amendments. Soil tests are effective in determining nutrient deficiencies and in indicating the amendments needed to correct these deficiencies.

Erosion control is not a problem on these soils, but they are flooded occasionally by streams or by runoff from higher areas. Shallow surface drains are used to remove trapped water. Drainage ditches and tile lines can be used to control the height of the water table. Although these soils were too wet for cultivation and were in native grass early in the 1900's, moderate to high yields of corn, grain sorghum, soybeans, and wheat are now obtained in fields drained by drainage ditches, road ditches, shallow field ditches, or tile lines. Yields on these soils can be further increased by even more improvement of drainage.

CAPABILITY UNIT IIw-6

The only soil in this unit is Wann fine sandy loam, deep. It occurs on nearly level bottom lands and is deep and moderately wet. It has a fine sandy loam surface soil and a subsoil with moderately rapid permeability.

This soil is fertile and well suited to cultivated crops. Cultivation and planting are often delayed because surface drains are lacking and the fluctuating water table rises into the root zone during winter and spring. When rainfall is below normal in spring and summer, water from the high water table benefits the crops.

On this soil, the choice of crops is not so wide as it is on the well-drained soils on bottom lands. Corn, grain sorghum, and soybeans are the principal crops. Wheat is planted in the fall in years when wetness prevents planting of other crops in the spring. Spring-seeded small grains are seldom grown. Yields of alfalfa vary because in some years the root zone is restricted by a high water table that damages plants.

Maximum yields from this soil are obtained by using management that maintains good tilth, returns crop residues to the soil, provides a balanced supply of plant nutrients, and improves drainage. Manure, fertilizers, and legumes are used to maintain fertility.

The type of farm has much to do with the selection of crops, the crop sequence, and the choice of amendments. On cash-grain farms commercial fertilizers are heavily applied to replace nutrients removed by crops. Soil tests are effective in determining nutrient deficiencies and in indicating the amendments needed to correct these deficiencies.

This soil is flooded occasionally by streams or by runoff from higher areas. Shallow surface drains are used to remove trapped water. Although this soil was too wet for cultivation early in the 1900's, moderate to high yields of crops can now be obtained in fields drained by drainage ditches, road ditches, shallow field ditches, or tile lines. Yields on this soil can be further increased by even more improvement in drainage.

The fine sandy loam surface layer is subject to shifting by the wind. Wind shifting is increased if crop residues are overgrazed, livestock trample the soil excessively in winter, or the top growth of plants is removed. Cover crops and crop residues on the surface protect the soil from the wind.

CAPABILITY UNIT IIs-2

The only soil in this unit is Butler silty clay loam. It is deep and occurs on flats and in slight depressions. It has a silty clay loam surface soil and a subsoil with slow permeability.

This soil is fertile and produces a wide variety of field crops. Most extensively grown are corn, wheat, oats, soybeans, legumes, and grasses. Because this soil is nearly level, runoff is slow, though the clayey subsoil takes in water slowly. Farming operations are frequently delayed by wetness, and the soil dries slowly after rains. The clayey subsoil releases water slowly to plants. As a result, crops that mature before the hot, driest part of summer are better suited to this soil than late-maturing crops. Small grains are better suited than corn or soybeans.

Moderately high yields of crops can be obtained year after year by using management that maintains good tilth, returns crop residues to the soil, and provides an abundant supply of plant nutrients. Manure, fertilizers, and legumes are used to maintain the fertility. Several light applications of nitrogen fertilizer in spring and early in summer are better than a single heavy application because the soil is frequently wet and poorly aerated and nitrogen may be leached from the root zone. Soil testing helps to determine nutrient deficiencies and indicates efficient use of soil amendments to correct these deficiencies.

The type of farm has much to do with the selection of crops, the crop sequence, and the choice of amendments. Cash-grain farmers rely heavily on commercial fertilizers to replace the plant nutrients removed by crops. Grain-

livestock farmers replace nutrients by adding manure and growing legumes and by supplementing these with fertilizers. To correct soil acidity, agricultural limestone should be applied in amounts indicated by soil tests.

Maintaining good tilth on this soil requires practices such as (1) returning crop residues to the soil; (2) avoiding tillage when the soil is too wet or too dry; and (3) avoiding unnecessary compaction by farm animals and machinery. The erosion hazard is slight. In many places excess water can be diverted from this soil. In adjacent cultivated areas, the direction of the rows can be arranged so that water does not drain onto this soil. Drainage of the surface can be increased in many places by shallow surface drains. Attempts to break up the clayey subsoil by mechanical methods are costly and seldom give lasting benefits. Deep-rooted crops, particularly those with large roots like alfalfa and sweetclover, penetrate the clayey subsoil. When the roots die and decay, channels are left that allow water and air to move through the soil.

CAPABILITY UNIT IIIe-1

This unit consists of deep soils that are on moderately sloping uplands and have a silt loam or silty clay loam surface soil and a subsoil with moderate to moderately slow permeability. The soils are—

Geary silty clay loam, 6 to 12 percent slopes, eroded.
Malcolm silt loam, 6 to 12 percent slopes, eroded.
Monona silt loam, 6 to 12 percent slopes.
Sharpsburg silty clay loam, 4 to 6 percent slopes, eroded.
Sharpsburg silty clay loam, 6 to 12 percent slopes, eroded.
Sharpsburg and Wymore silty clay loams, 4 to 6 percent slopes, eroded.
Sharpsburg and Wymore silty clay loams, 6 to 12 percent slopes, eroded.

These soils are fertile, easily tilled, and well suited to cultivated crops. Figure 26 shows common uses of Sharpsburg silty clay loams. Most frequently grown are corn, wheat, oats, sorghums, legumes, and grasses. The soils take in and store water readily and release it readily to plants. The hazard of water erosion is moderate. Continued high yields are obtained by using management that maintains good tilth, returns crop residues to the soil, provides an abundant supply of plant nutrients, and lessens the erosion hazard. Manure, fertilizers, and legumes are used to maintain an abundant supply of plant nutrients.

The type of farm has much to do with the selection of crops, the crop sequence, and the choice of amendments. On cash-grain farms commercial fertilizers are heavily applied to replace the plant nutrients removed by crops. On grain-livestock farms the nutrients are replaced by adding manure and growing legumes and supplementing these with fertilizers. Soil testing is helpful in determining nutrient deficiencies and in indicating soil amendments needed to correct these deficiencies. To correct acidity, agricultural limestone should be applied in amounts indicated by soil tests.

Figure 26.—**Cultivated Sharpsburg silty clay loams on moderately sloping uplands.**

Maintaining good tilth on these soils requires practices such as (1) returning organic residues to the soil; (2) varying the depth of plowing to prevent compaction of the soil immediately below the furrow slice; (3) avoiding tillage when the soil is too wet or too dry; and (4) avoiding unnecessary compaction by farm animals and machinery.

Management practices that lessen the erosion hazard are supplemental to other good management practices. Suitable for all areas of these soils are contour cultivation, terracing, stripcropping, grassing of waterways, seeding of field borders, and returning crop residues to the soil.

Smoothing, shaping, and seeding is required in gullied areas and in channels cut in drainageways. If the gradient of the channel is too steep for grass sod to protect it, structures are needed that slow the water and protect the channel from scouring.

CAPABILITY UNIT IIIe-2

In this unit are deep soils on moderately sloping uplands that have a clay loam surface soil and a subsoil with slow permeability. The soils are—

Adair clay loam, 6 to 9 percent slopes, eroded.
Pawnee clay loam, 6 to 9 percent slopes, eroded.

These soils take in water slowly and release it slowly to plants. Much of the rain runs off instead of entering the soil. Because of the low intake of water and the strong slopes, runoff is so rapid that erosion control is a major problem in managing these soils.

Generally, there is not enough water to meet the needs of summer crops. Wheat, oats, sorghums, alfalfa, sweetclover, and grasses are less likely to be damaged by drought than corn or soybeans. Small grains are harvested before the dry, hot summer. Sorghums, alfalfa, sweetclover, and grasses stop growing when moisture is scarce, but they recover and continue to grow when more moisture is available.

The fertility of these soils was high, but erosion has removed most of the original surface layer, and the soils are now less productive than they were 30 or 40 years ago. To maintain or increase the productivity, management is needed that maintains good tilth, returns crop residues to the soil, provides an abundant supply of plant nutrients, and controls erosion. Soil tests are helpful in determining nutrient deficiencies and in indicating the soil amendments needed to correct these deficiencies.

Manure, fertilizers, and legumes are used to maintain an abundant supply of plant nutrients. Good tilth is obtained by practices such as (1) returning organic residues to the soil; (2) avoiding tillage when the soil is too wet or too dry; and (3) avoiding unnecessary compaction by farm animals and machinery.

In cultivated areas erosion can be controlled by using terraces, cultivating on the contour, grassing the water-

ways, keeping crop residues on the surface, and limiting the use of clean-tilled crops. Smoothing, shaping, and seeding are required in gullied areas and in channels cut in drainageways. If the gradient of the channel is too steep for grass sod to protect it, structures are needed that slow the water and protect the channel from scouring. Woodland or plantings for food and cover for wildlife may be the most practical use for severely gullied areas and small irregular areas caused by rearrangement of fields.

CAPABILITY UNIT IIIe-3

The only soil in this unit is Judson fine sandy loam, 2 to 6 percent slopes. It is deep and loamy and occurs on moderately sloping foot slopes.

This fertile soil is easily tilled and well suited to cultivated crops. Most extensively grown are corn, wheat, oats, sorghums, legumes, and grasses. This soil takes in and stores water readily and releases it readily to plants. The hazard of wind erosion is slight, and the hazard of water erosion is moderate.

Continued high yields are insured by using management that maintains good tilth, returns crop residues to the soil, provides an abundant supply of plant nutrients, and lessens the erosion hazard.

Manure, fertilizers, and legumes are used to maintain an abundant supply of plant nutrients. Maintaining good tilth on these soils requires practices such as (1) returning organic residues to the soil; (2) avoiding tillage when the soil is too wet or too dry; and (3) avoiding unnecessary compaction by farm animals and machinery.

This soil occupies the lower slopes. Where runoff from the upper slopes is not controlled by terraces, a diversion terrace can be constructed at the upper edge of this soil to divert the runoff water to a suitable outlet. Then the area below the diversion can be terraced and farmed on the contour the same way as upland slopes of similar gradient are farmed. Grassed waterways are needed to convey the runoff water. In some large drainageways structures are needed that stabilize the grade.

The surface of this fine sandy loam is likely to be shifted by the wind. The hazard of wind erosion is lessened by maintaining a protective cover and preventing excessive trampling by livestock during the winter.

CAPABILITY UNIT IIIe-5

In this unit are deep, well-drained, sandy soils on nearly level and hummocky bottom lands. The soils are—

Sarpy loamy fine sand.
Sarpy loamy fine sand, loamy substratum.

These soils take in water readily and release it readily to plants. They have a low water-holding capacity and are somewhat droughty. The sandy surface soil is easily shifted by the wind. Fertility is low, and crop yields depend on the management practices used. Corn, sorghums, rye, sweetclover, and grasses are grown successfully, but a continuous ground cover is needed to prevent the surface soil from shifting. The hazard of wind erosion can be lessened by keeping crop residues or cover crops on the surface, growing green-manure crops, and restricting grazing.

Manure, fertilizers, and legumes are needed to maintain an abundant supply of plant nutrients. Soil tests are helpful in determining nutrient deficiencies and in indicating amendments needed to correct these deficiencies. Under good management these soils are productive, but under poor management yields are low and sand blown from these soils damages crops on adjacent soils and drifts into fence rows, onto roadways, and into ditches.

CAPABILITY UNIT IIIe-8

The soils in this unit are deep, are eroded or severely eroded, and occur on moderately sloping uplands. They are—

Monona silt loam, 6 to 12 percent slopes, eroded.
Sharpsburg silty clay loam, 6 to 12 percent slopes, severely eroded.
Sharpsburg and Wymore silty clay loams, 6 to 12 percent slopes, severely eroded.

These soils were once fertile, easily tilled, and well suited to cultivated crops, but erosion has reduced their fertility. The intake of rainfall has been slowed, and much water runs off instead of entering the soils. Good management that includes practices to control erosion increases the water intake and restores the fertility. High yields can be obtained by using management that provides good tilth, returns crop residues to the soil, provides an abundant supply of plant nutrients, and controls erosion.

The type of farm has much to do with the selection of crops, the crop sequence, and the choice of amendments. Manure, fertilizers, and legumes are used to maintain an abundant supply of plant nutrients. Cash-grain farmers rely heavily on commercial fertilizers to replace the plant nutrients removed by crops. Grain-livestock farmers replace the nutrients by adding manure and growing legumes and by supplementing these with fertilizers. Soil tests are effective in determining nutrient deficiencies and in indicating amendments needed to correct these deficiencies. To correct acidity, agricultural limestone should be applied in amounts indicated by soil tests.

Maintaining good tilth on these soils requires practices such as (1) returning organic residues to the soil; (2) varying the depth of plowing to prevent compaction of the soil immediately below the furrow slice; (3) avoiding tillage when the soil is too wet or too dry; and (4) avoiding unnecessary compaction by farm animals and machinery.

Practices that lessen the erosion hazard supplement other good management. Suitable for all areas of these soils are contour cultivation, terracing, stripcropping, grassing the waterways, seeding the field borders, and returning crop residues to the soils. Smoothing, shaping, and seeding are required in gullied areas and in channels cut in drainageways. If the gradient of the channel is too steep for grass sod to protect it, structures are needed that slow the water and protect the channel from scouring.

CAPABILITY UNIT IIIw-1

Luton clay is the only soil in this unit. It is deep and clayey and occurs on imperfectly drained bottom lands that are seldom flooded.

If this fertile soil is carefully managed, it produces good yields of corn, wheat, and grasses. Corn, soybeans, and wheat are the principal crops. The high content of clay makes tillage difficult. In years when precipitation is above average, this soil is cold and wet and planting is delayed. During prolonged dry periods, crops are damaged by lack of moisture.

Surface drainage is required in cultivated areas. Areas without adequate surface drainage are in native grasses that are used for hay or pasture. Practices that help to drain this soil are arrangement of row direction, surface bedding, field drains, and control of weeds in drainage ditches.

Management is needed that maintains good tilth, provides an abundant supply of plant nutrients, and maintains the supply of organic matter. Excessive compaction by machinery or livestock should be avoided, particularly when the soil is wet, because compaction reduces the permeability to air and water. Dry fields are cloddy. They take in water slowly, and crops become yellowish because there is nitrogen deficiency resulting from deoxidation of nitrates. Starter fertilizers containing nitrogen are beneficial, and several light applications of nitrogen are better than a single heavy application. Fall plowing is beneficial because it increases aggregation of the soil, but at the same time it exposes the soil to wind erosion. Each farmer should evaluate the benefits and hazards for his farm. Winter cover crops and crop residues protect the surface from blowing, but drying of the soil in spring is slowed if the residues are too heavy.

CAPABILITY UNIT IIIw-2

The only soil in this unit is Fillmore silty clay loam. This deep soil occurs in depressions of the uplands and is subject to ponding. Its subsoil is slowly permeable.

Water collects in the swales and slightly depressed flats and stands until it is absorbed or evaporated. The ponded water generally remains long enough to damage corn, wheat, and similar crops. If surface drainage is provided, fairly good yields of grain sorghum and small grains can be expected, but wetness often delays planting. Yields are not so high as they are on well-drained soils, and in most places the response to fertilizers, particularly nitrogen, is less. Starter fertilizers benefit spring-seeded crops. Several light applications of nitrogen fertilizer in spring and early in summer are better than a single heavy application because the soil is frequently wet and poorly aerated and the nitrogen may be leached from the root zone. The need for lime and fertilizers should be determined by soil tests. Wheat benefits from an application of nitrogen in the spring.

Field drains, arrangement of row direction, and open drainage ditches improve surface drainage. Runoff from adjacent areas can often be diverted. Tile drainage is not used in many places, because the clay subsoil slows the movement of water and outlets for the drains are difficult to provide because of the position of the soils. Erosion is not a problem if crop residues are left on the soil after harvesting to protect it during winter. Excessive trampling by livestock and compacting by machinery reduce water movement in the soil, reduce aeration, and increase the difficulty of tillage and management.

CAPABILITY UNIT IIIw-5

Sarpy loamy fine sand, imperfectly drained, is the only soil in this unit. This deep, sandy soil occurs on moderately wet bottom lands of the Platte River.

This soil takes in water readily and releases it readily to plants. It has a low water-holding capacity, but the moderately high water table supplies some moisture to the crops during dry years. This soil is susceptible to severe wind erosion, is low in organic matter and available plant nutrients, and is somewhat droughty.

Corn, grain sorghum, rye, sweetclover, and tame grasses are grown successfully, but planting is frequently delayed in spring by wetness. Maintaining a surface cover throughout the year reduces wind erosion. Rye and vetch can be used as cover crops and green-manure crops. Crop residues should remain on the soil during winter. If minimum tillage is used, crop residues are left on the surface until cover is provided by growing crops. Residue management, cover crops, and barnyard manure increase fertility and the organic matter in the soil. The application of commercial fertilizers and lime should be guided by soil tests.

CAPABILITY UNIT IIIw-6

The only soil in this unit is Wann fine sandy loam, moderately deep. This imperfectly drained soil occurs on bottom lands. It has a fine sandy loam surface soil and a subsoil with moderately rapid permeability.

This soil takes in water readily and releases it readily to plants, but it has a low water-holding capacity. The water table is high enough to keep the subsoil moist during periods of normal or above normal rainfall. The hazard of wind erosion is moderate. The soil is low in organic matter and available plant nutrients.

Corn, grain sorghum, sweetclover, and tame grasses are grown. Maintaining a surface cover throughout the year reduces wind erosion. Rye and vetch can be used as cover crops or green-manure crops. Cover crops or crop residues should remain on the soil during winter. If minimum tillage is used, crop residues are left on the soil until cover is provided by growing crops. This soil is generally calcareous and low in available phosphorus. Soil tests help to determine the amount and kind of fertilizers needed. A cropping system that insures large amounts of crop residues helps reduce erosion and helps maintain productivity of this soil. Ponding of the many swales and partly filled former river channels can be prevented in many places by shallow surface drains. Water can be kept from entering many of the low areas by arranging the direction of rows.

CAPABILITY UNIT IIIs-1

Lamoure silty clay loam, alkali, is the only soil in this unit. It is deep, moderately wet, and has a silty clay loam surface soil and a subsoil with moderately slow to slow permeability

The kinds of crops grown and the yields obtained are limited by concentrations of salts and alkali that vary greatly in amount within short distances. Because the water table is moderately high, the salts tend to accumulate in the root zone. The soil takes in water slowly, but it remains wet and sticky after rains and is difficult to till. If the water table can be lowered by drainage, the soils can be reclaimed by adding amendments that correct the alkalinity and by leaching the soluble salts. Large additions of organic matter lessen the effect of the alkali salts on crops. Salt-tolerant crops have the highest yields. Soil tests are needed to determine the kind and amount of salts.

Barley, sorghums, and wheat are better suited than corn, oats, or soybeans. Yields of alfalfa are fairly good, and forage yields of salt-tolerant wheatgrasses are good. Manure, fertilizers, and legumes are needed to maintain the supply of plant nutrients. If drainage is improved,

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saline-alkali salts do not accumulate, and those already accumulated can be removed. Good tilth can be obtained by using practices such as (1) adding large quantities of organic matter in the form of manure or crop residues; (2) avoiding unnecessary compaction of the soil by farm animals and machinery; and (3) keeping a cover of crop residues on the surface to prevent crusting after rains.

CAPABILITY UNIT IVe-1

The soils in this unit are deep and occur on strongly sloping uplands. They have a silt loam to silty clay loam surface soil and a subsoil with moderate to moderately slow permeability. They are—

- Burchard and Shelby clay loams, 12 to 17 percent slopes.
- Burchard and Shelby clay loams, 12 to 17 percent slopes, eroded.
- Monona silt loam, 12 to 17 percent slopes.
- Morrill clay loam, 6 to 12 percent slopes, eroded.
- Sharpsburg silty clay loam, 12 to 17 percent slopes, eroded.
- Sharpsburg and Wymore silty clay loams, 12 to 17 percent slopes, eroded.
- Shelby and Burchard clay loams, 6 to 12 percent slopes.
- Shelby and Burchard clay loams, 6 to 12 percent slopes, eroded.

These soils absorb and store water readily, and they release it readily to plants. Surface runoff is very rapid, and the erosion hazard is severe. The soils are low to moderately low in content of organic matter and of available plant nutrients.

Suitable crops are corn, grain sorghum, wheat, alfalfa, sweetclover, and tame grasses. The erosion hazard can be reduced by mechanical practices such as terracing, contour farming, grassing the waterways, and controlling gullies; and by agronomic practices that provide protective cover, increase infiltration, reduce runoff, and restore and maintain the fertility. Growing annual crops year after year causes a serious erosion hazard, but annual crops can be grown if perennial crops are used in the cropping sequence and the soils are intensively managed. A row crop can be grown for 1 year and followed by a small grain. A good cropping sequence is 2 or 3 years of annual crops followed by several years of legumes and grasses. If intensive management and a suitable cropping sequence are not used, these soils should be kept in permanent grasses for forage.

CAPABILITY UNIT IVe-2

In this unit are deep soils that occur on moderately sloping uplands and have a silty clay loam or clay loam surface soil. The subsoil is clayey and slowly permeable. The soils are—

- Adair clay loam, 9 to 12 percent slopes, eroded.
- Pawnee clay loam, 9 to 12 percent slopes, eroded.

Because of the strong slopes and clayey subsoil that takes in water slowly, runoff is rapid on these soils and the hazard of further erosion is severe. The soils contain little organic matter and only a small amount of available plant nutrients. Controlling erosion and conserving moisture are major problems in managing these soils.

These soils are best suited to a cropping system that keeps the soils in small grains and grass much of the time. Because of the erosion hazard, a clean-tilled crop should not be followed by another. The cropping system is suitable if grass or grass and legumes are kept on these soils at least half the time. Good management includes terracing, contour farming, applying fertilizers, and grassing the waterways that carry water from the terraces.

CAPABILITY UNIT IVe-3

Only Ortello complex, 6 to 12 percent slopes, eroded, is in this unit. It is made up of deep, moderately permeable to rapidly permeable, loamy soils that occur on sloping uplands.

These soils have a low capacity for storing moisture and a small amount of available plant nutrients. They are subject to moderate erosion if they are planted to annual crops continuously. The sandy subsoil and substratum erode easily, and after gullies start to form, they deepen quickly.

The crop sequence is suitable if it consists chiefly of small grains and legumes and grasses. Row crops such as corn or grain sorghum should not be followed by another row crop. Wind erosion can be checked by keeping crop residues or growing crops on the soils throughout the year. Needed to control water erosion are terraces, contour cultivation, grassed waterways, and practices to prevent gullying. Also needed are practices that return large amounts of organic matter to the soil. Fertilizers and lime should be applied as indicated by soil tests.

Because the subsoil and substratum are sandy, grassed waterways are difficult to maintain in some places. In many places structures are required to stabilize gullies because the vegetation is not effective in doing this. Farm ponds are likely to lose much water through seepage. At the turnrows, water erosion can be controlled by seeding grass along field borders. Many areas of these soils can be best used by managing them so that they produce trees, hay or pasture, or cover for wildlife.

CAPABILITY UNIT IVe-8

The soils in this unit are deep and occur on moderately sloping to strongly sloping uplands. They have an eroded silt loam to silty clay loam surface soil and a subsoil with moderate to moderately slow permeability. The soils are—

- Geary silty clay loam, 6 to 12 percent slopes, severely eroded.
- Monona silt loam, 12 to 17 percent slopes, eroded.
- Monona silt loam, sand substratum, 6 to 12 percent slopes, eroded.
- Morrill clay loam, 6 to 12 percent slopes, severely eroded.
- Sharpsburg silty clay loam, 12 to 17 percent slopes, severely eroded.
- Sharpsburg and Wymore silty clay loams, 12 to 17 percent slopes, severely eroded.
- Shelby and Burchard clay loams, 6 to 12 percent slopes, severely eroded.

The original dark-colored surface soil has been removed by erosion, and the material from the subsoil is exposed. These soils are very low in organic-matter content and are low in available plant nutrients. Erosion control is a major problem in managing these soils.

Suitable crops are corn, sorghums, alfalfa, sweetclover, and wheat and tame and native grasses. Because of the severe erosion hazard, these soils should be kept in legumes or a legume and grass mixture about 75 percent of the time. Erosion can be controlled if management is intensive and includes terracing, contour farming, managing residues, grassing the waterways, and controlling gullies. If livestock is raised, hay and pasture can be used profitably, and barnyard manure is available to help maintain the fertility and organic-matter content of these soils. Adequately fertilized crops produce enough plant residues to provide an ample supply of organic matter.

CAPABILITY UNIT IVw-2

Fillmore silty clay loam, ponded, is the only soil in this unit. It is a deep soil in ponded depressions on the uplands. Its subsoil is slowly permeable.

This soil is cultivated only occasionally because water generally stands on the surface. Most areas cannot be drained, but they support a stand of wheatgrass that can be grazed. The lowest lying areas are in weeds or annual grasses. If they are properly managed, areas large enough to be fenced and pastured produce moderate yields of forage. Small areas that are not cultivated or grazed provide cover for upland game birds.

CAPABILITY UNIT IVs-4

Platte loam is the only soil in this unit. It is a shallow soil that occurs on the bottom lands of the Platte River and has a loam surface layer underlain by sand and gravel at a depth of 10 to 20 inches.

This shallow soil can store only a small amount of moisture, and it contains only a small amount of plant nutrients. Crops that mature early in summer, mainly wheat or rye, are grown. The soil is too droughty for alfalfa, corn, and sorghums. A normal amount of native and tame grasses is produced in spring and early in summer, but little moisture is available late in July and August, and little forage is produced. Irrigation increases yields of crops and forage, but generally not enough to warrant its cost.

CAPABILITY UNIT Vw-6

This unit consists of wet sandy to clayey soils on nearly level bottom lands. A water table is at or near the surface most of the time. The soils are—

Barney soils.
Rauville soils.

These soils are so wet that they cannot be tilled. Most areas are used for native pasture or hay. The amount of forage produced varies greatly and depends on the kinds of grasses and the degree of wetness. Some areas would produce more forage if they were reseeded to tall wheatgrass and reed canarygrass. Coarse grasses are dominant, and grazing should be managed so that the forage does not become woody and unpalatable. In extremely wet areas, the forage can be improved by restricting grazing in winter and early in spring.

CAPABILITY UNIT VIe-1

In this unit are deep, strongly sloping to steep soils that have a silt loam or clay loam surface soil and a subsoil with moderate to moderately slow permeability. The soils are—

Monona silt loam, 17 to 30 percent slopes.
Steinauer clay loam, 12 to 30 percent slopes.

These soils are best suited to native grasses or trees because slopes are steep and runoff is excessive. The grasses on these soils are big bluestem, little bluestem, Indiangrass, switchgrass, side-oats grama, western wheatgrass, and green needlegrass.

Grazing should be controlled so that about half of the growth each year is left on the soils at the end of the grazing season. This growth keeps the grasses vigorous and protects ths soils from erosion by furnishing a cover and mulch.

CAPABILITY UNIT VIe-2

Only Adair and Pawnee soils, 6 to 12 percent slopes, severely eroded, are in this unit. These deep, moderately sloping soils are on uplands. They have a clay surface soil that is underlain by a slowly permeable claypan.

These soils are best suited to permanent grasses. Erosion has removed the original dark-colored, friable surface layer and has exposed the dense, clayey subsoil. These soils take in water very slowly. Cultivated fields are difficult to manage because tilth is poor and erosion is severe. The content of organic matter and the amount of available plant nutrients are low.

A mixture of native grasses can be established if it is seeded in the stubble from a crop of sorghum or sudangrass. Suitable grasses are big bluestem, little bluestem, switchgrass, Indiangrass, side-oats grama, and western wheatgrass. Grazing should be controlled so that about 50 percent of the growth each year is left on the soils at the end of the grazing season. This cover insures plants sufficient vigor to start growing the next year, and it provides a cover to protect the soils against erosion. Because fertility is low, manure or fertilizers are needed to establish grasses and to increase forage production after the grasses are established.

CAPABILITY UNIT VIe-3

Only Ortello complex, 12 to 17 percent slopes, eroded, is in this unit. The deep soils in this complex are on strongly sloping breaks in the Todd Valley. The surface soil is fine sandy loam, and the subsoil and underlying material have moderately rapid to rapid permeability.

These soils are not suited to cultivation. They have had their original dark-colored surface layer removed by erosion, and they are susceptible to further erosion because they are steep and sandy. Also, these soils are low in content of organic matter and plant nutrients.

These soils should be kept in native grasses or trees. Although native grasses begin to grow slowly, they can be established if they are seeded in the stubble of sudangrass or sorghum. Suitable grasses are sand bluestem, switchgrass, Indiangrass, side-oats grama, little bluestem, and western wheatgrsss. Seeded areas generally are not grazed for 2 or 3 years.

Good management includes grazing practices that leave about 50 percent of the growth each year on the soil at the end of the grazing season.

CAPABILITY UNIT VIe-5

The fine sandy soils in this unit are along the Platte River on rough bottom lands that have been cut by many channels. These soils consist of stabilized riverwash material. They are—

Sarpy fine sand.
Sarpy fine sand, hummocky.

These soils are not suitable for cultivation. They are best suited to permanent grasses. Water-holding capacity is very low, and the soils are droughty. They contain a small amount of available plant nutrients. Wind erosion is a severe hazard if the surface is not protected by growing plants.

Native grasses can be established if they are seeded in the stubble of sorghum or sudangrass that was planted or seeded the preceding year. Suitable grasses are big bluestem, little bluestem, switchgrass, Indiangrass, blue grama,

and sand lovegrass. Grazing should be controlled so that 50 percent of the growth each year is left on the soils at the end of the grazing season. This furnishes cover that helps control erosion.

CAPABILITY UNIT VIe-8

In this unit are deep, strongly sloping to steep soils that have a thin or severely eroded silt loam or clay loam surface soil and a subsoil with moderate to moderately slow permeability. The soils are—

Burchard and Shelby clay loams, 12 to 17 percent slopes, severely eroded.
Monona silt loam, sand substratum, 12 to 30 percent slopes, eroded.

These soils are best suited to grasses because slopes are steep, runoff is excessive, and the hazard of sheet and gully erosion is severe in cultivated areas (fig. 27). In the severely eroded areas, fertility and organic-matter content are low.

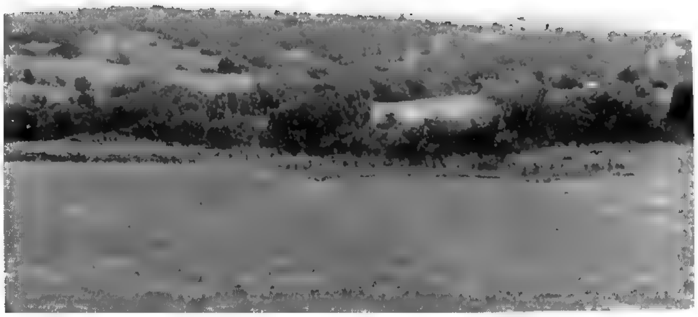

Figure 27.—**Monona soils occupy most of these steeply sloping hills.**

Native grasses are easily established if the soils are prepared by growing a cover crop of sudangrass or sorghums and seeding a mixture of native grasses in the stubble. Severely gullied or eroded areas should be smoothed before seeding the cover crop. Suitable native grasses are big bluestem, little bluestem, Indiangrass, switchgrass, side-oats grama, western wheatgrass, and green needlegrass. Grazing should be controlled so that about 50 percent of the growth each year is left on the soils at the end of the grazing season. This growth keeps the grasses vigorous and protects the soils from erosion by furnishing a cover and mulch.

CAPABILITY UNIT VIw-1

Only Alluvial land is in this unit. It is made up of deep, silty, frequently flooded soils that occur on bottom lands along upland drains.

These soils are not suited to cultivation. They are frequently flooded, or they occur in small areas along crooked streams. The vegetation consists of trees, shrubs, weeds, and grasses.

Alluvial land is best suited to pasture or trees. Good practices of pasture management provide proper stocking rates, rotation grazing, and deferred grazing. Some reseeding of grasses may be needed at times in flooded areas. Cultivation may be possible if stream channels are improved and the watershed is managed to reduce flooding. Nearly all areas are fertile, but their location limits use for cultivated crops.

CAPABILITY UNIT VIw-5

Only Mixed alluvial land is in this unit. It occurs on wet bottom lands of the Platte River and is light colored and sandy. Sand or sand and gravel is at a depth of 6 to 24 inches. Because of the many channels, relief is irregular.

The soils that make up this land are not suitable for cultivation. They are likely to be flooded when the Platte River is high.

Grasses or trees are best on these sandy soils. A cover crop used as a preparatory crop helps in establishing grasses. Management of the pasture should provide grazing practices that allow 50 percent of the growth each year to remain at the end of the grazing season.

CAPABILITY UNIT VIs-1

This unit consists of strongly saline or alkali soils on moderately wet bottom lands. The soils have a sandy to clayey surface soil and a subsoil with moderately rapid to slow permeability. They are—

Leshara silt loam, alkali.
Luton soils, saline.
Wann fine sandy loam, alkali.

These soils are not suitable for cultivated crops. They contain much soluble salt or are highly alkaline, and they take in water slowly and release it slowly to plants.

These soils are best suited to tall wheatgrass, western wheatgrass, reed canarygrass, and other grasses tolerant of salt and alkali. Good grazing management is needed in grassed areas. Yields of forage are increased if fertilizers are added in amounts indicated by soil tests.

CAPABILITY UNIT VIIe-1

Only Gullied land is in this unit. It is steep and very steep and is dissected by deep, active gullies.

This land is best suited to grasses, trees, or shrubs. In many unstable areas it is necessary to smooth slopes with a bulldozer, to divert water from the areas, or to build drop structures or use other means to control gullies. Unless active gullies are controlled, this land is of little use for forage or wood products. Many areas should be fenced to exclude livestock. Cover for upland game birds can be provided by planting shrubs, trees, and grasses. Suitable fish may be stocked in the water impounded by gully-control dams. Areas large enough may be suitable for developing as recreational areas.

CAPABILITY UNIT VIIs-1

Only Made land is in this unit. It consists of altered soil material. Areas of Made land are not suitable for producing grain or forage crops, but areas that are planted and fenced can be used by wildlife, mainly upland game birds. Some areas are spoil banks along drainage ditches, and others consist of waste sand around gravel pits. If trees, shrubs, and grasses are planted or seeded along the drainage ditches, they stabilize the spoil banks and provide cover for game birds and for animals. The areas of sand around the gravel pits can support a thin stand of sand reedgrass, tall dropseed, and other grasses. Sand cherry and cottonwood can also be grown in most places. These grasses and trees make the areas more attractive for recreational purposes.

CAPABILITY UNIT VIIIw-3

Riverwash is the only land type in this unit. It is a nonagricultural land that is best suited as wildlife habitats. It consists of sandbars in and adjacent to the channels of the Platte River.

Predictions of Yields

Average yields of principal crops are given in table 2 for two levels of management. For most crops, yields are listed for both irrigated soils and dry-farmed soils.

The yields in columns B are those expected when management is at a high level. Those in columns A are expected when the farmer does not carry out all the practices of management at a high level.

To keep management at a high level and thus obtain the yields in columns B, a farmer must—

1. Use a cropping sequence that helps maintain tilth and the supply of plant nutrients.
2. Apply fertilizer and lime in amounts indicated by soil tests.
3. Use number of plants or amount of seed appropriate for the soil.
4. Cultivate, seed, and harvest with care.
5. Plant suitable crop varieties.
6. Control insects, weeds, and diseases.
7. Use practices to control wind and water erosion.
8. Improve drainage if needed.
9. Perform all practices at the proper time.

Native Grassland and Tame Pasture

The original vegetation on uplands in the county was tall prairie grasses that furnished excellent grazing for the native range animals and for the early settlers' livestock. Since settlement began, however, all except 7 percent of the county has been plowed. Of this 7 percent, most areas are in tame pasture, but a few are in native grasses.

Native grassland

The native grasses on well-managed soils of the uplands are mainly big bluestem, Indiangrass, switchgrass, and little bluestem. Overgrazed grassland in poor condition consists mostly of Kentucky bluegrass, tall dropseed, blue vervain, ironweed, and annuals. Well-managed nonalkali soils on bottom lands produce prairie cordgrass, tall sedges, big bluestem, Indiangrass, and switchgrass. The well-managed alkali soils on bottom lands produce salt-tolerant sedges, switchgrass, western wheatgrass, and inland saltgrass.

Most of the native grassland has been so closely grazed that the original tall grasses have been eliminated. Also, areas in native grasses are so small that they are difficult to manage as range. Overstocking is common, and the grassland tends to be weedy. Some areas are invaded by brushy shrubs, and bluegrass has replaced a considerable part of the growth in areas that once supported tall native grasses.

The overgrazed grassland can be restored by using good management that includes proper degree of use, deferred grazing, and reseeding where needed. In areas where the original tall grasses have been completely eliminated, the cover can be restored most quickly by reseeding.

Management of tame grass pasture [2]

Bromegrass is the most common tame grass in Saunders County. On soils suitable for cultivation, farmers seed tame grass in a long cropping system with cultivated crops. Tame pasture is also used to supplement native grass pasture and thus to provide a longer grazing season and to permit better management of the native pasture.

Grazing early in spring, during the critical period of growth, damages established pasture. During this period the grasses feed on reserves stored in their roots and rhizomes. The period lasts until the grasses are 5 or 6 inches high. Also, grazing should be stopped soon enough to allow the grasses to make 6 to 8 inches of growth before the first killing frost in fall. During this period the grasses store food reserves for growth the next spring.

Weeds in pastures can be controlled best by using chemicals. Mowing weeds also clips the taller grasses and damages them as much as it does the weeds.

Fertilizer, particularly nitrogen, is needed for highest production. On pasture mixtures that include a legume, phosphate fertilizer is generally beneficial. The amount and kinds of fertilizer to apply are indicated by the results of soil tests, but the amount of available moisture in the soil also must be considered.

Grazing in July and August can be provided by temporary pasture of sudangrass, for in these months bromegrass, bluegrass, and the wheatgrasses are semidormant. Green grazing can be provided for livestock throughout the growing season by using a combination of pasture seeded to cool-season grasses, pasture seeded to warm-season grasses, and temporary pasture of sudangrass.

Tame pasture and native grassland compared

Grasses suitable for seeding on tame pasture generally differ from those suitable for seeding on native grassland. Introduced species, particularly bromegrass, are seeded on most tame pastures in the county. A tame pasture on saline and alkali soils, however, is better suited to tall wheatgrass. Good management of tame pasture provides grazing when forage quality is highest, and the main purpose of this management is highest possible production. Stand maintenance is secondary.

Native grass seedings consist of several native species in a mixture comparable to that originally on the land. Management aims at both stand maintenance and maximum production. The native grassland generally has a wider variety of grasses than tame pasture. But on native grassland, production and cost of production are generally lower than they are on tame pasture. Consequently, the tame pasture should be on more productive soils than the native grasses. Because costs are low on native grassland, yields of forage also can be low.

Nature is constantly trying to put back the kind of plants that originally grew, as can be seen on soils that were cleared, cultivated, and later abandoned. If locally adapted strains of native grasses are seeded, and management is good, the most profitable yields generally can be obtained from tame grasses on soils in classes I, II, and III and from native grasses on soils in classes VI and VII. On soils in class IV, either tame or native grasses may be used.

[2] By ERVIN O. PETERSEN, conservation agronomist, Soil Conservation Service.

TABLE 2.—*Average acre yields of principal*

[Yields in columns A are those obtained under a low level of management; yields in columns B are those obtained

Soil	Corn				Wheat	
	Dryland		Irrigated			
	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Adair clay loam, 6 to 9 percent slopes, eroded	25	40	----	----	15	20
Adair clay loam, 9 to 12 percent slopes, eroded	12	25	----	----	10	15
Adair and Pawnee soils, 6 to 12 percent slopes, severely eroded	15	25	----	----	10	15
Alluvial land	----	----	----	----	----	----
Barney soils	----	----	----	----	----	----
Burchard and Shelby clay loams, 12 to 17 percent slopes	25	40	----	----	15	20
Burchard and Shelby clay loams, 12 to 17 percent slopes, eroded	20	35	----	----	15	20
Burchard and Shelby clay loams, 12 to 17 percent slopes, severely eroded	15	25	----	----	10	15
Butler silty clay loam	45	60	70	90	30	35
Cass fine sandy loam, moderately deep	30	45	----	----	15	25
Cass fine sandy loam, deep	50	65	70	85	20	30
Colo silty clay loam	50	70	----	----	25	30
Colo silty clay loam, clayey substratum	45	65	----	----	20	25
Fillmore silty clay loam	30	40	50	65	15	20
Fillmore silty clay loam, ponded	----	----	----	----	----	----
Geary silty clay loam, 6 to 12 percent slopes, eroded	35	50	----	----	20	30
Geary silty clay loam, 6 to 12 percent slopes, severely eroded	20	35	----	----	15	20
Gullied land	----	----	----	----	----	----
Hobbs soils	45	65	----	----	15	25
Judson fine sandy loam, 2 to 6 percent slopes	50	65	----	----	20	30
Judson silty clay loam, 2 to 6 percent slopes	55	75	70	95	30	35
Lamoure silty clay loam	45	65	----	----	20	25
Lamoure silty clay loam, alkali	30	40	----	----	15	20
Leshara silt loam, deep	50	75	70	85	20	25
Leshara silt loam, alkali	----	----	----	----	----	----
Leshara silt loam, moderately deep	40	55	60	75	20	25
Luton clay	45	65	----	----	25	30
Luton soils, saline	----	----	----	----	----	----
Made land	----	----	----	----	----	----
Malcolm silt loam, 6 to 12 percent slopes, eroded	30	45	----	----	20	25
Mixed alluvial land	----	----	----	----	----	----
Monona silt loam, 6 to 12 percent slopes	45	65	----	----	25	30
Monona silt loam, 6 to 12 percent slopes, eroded	40	60	----	----	20	25
Monona silt loam, 12 to 17 percent slopes	35	50	----	----	15	20
Monona silt loam, 12 to 17 percent slopes, eroded	30	45	----	----	15	20
Monona silt loam, 17 to 30 percent slopes	----	----	----	----	----	----
Monona silt loam, sand substratum, 6 to 12 percent slopes, eroded	35	50	----	----	15	20
Monona silt loam, sand substratum, 12 to 30 percent slopes, eroded	----	----	----	----	----	----
Morrill clay loam, 6 to 12 percent slopes, eroded	35	50	----	----	20	25
Morrill clay loam, 6 to 12 percent slopes, severely eroded	20	30	----	----	10	20
Muck	55	70	----	----	----	----
Muir silty clay loam	55	80	----	----	25	35
Ortello complex, 6 to 12 percent slopes, eroded	15	30	----	----	10	20
Ortello complex, 12 to 17 percent slopes, eroded	----	----	----	----	----	----
Pawnee clay loam, 6 to 9 percent slopes, eroded	25	40	----	----	15	20
Pawnee clay loam, 9 to 12 percent slopes, eroded	15	25	----	----	10	15
Platte loam	15	30	----	----	10	15
Rauville soils	----	----	----	----	----	----
Riverwash	----	----	----	----	----	----
Sarpy fine sand	----	----	----	----	----	----
Sarpy fine sand, hummocky	----	----	----	----	----	----
Sarpy loamy fine sand	20	35	40	60	10	15
Sarpy loamy fine sand, imperfectly drained	25	40	40	60	15	20
Sarpy loamy fine sand, loamy substratum	30	45	45	65	20	25
Sharpsburg silty clay loam, 0 to 2 percent slopes	50	70	75	100	30	35
Sharpsburg silty clay loam, 2 to 4 percent slopes	45	65	65	90	25	35
Sharpsburg silty clay loam, 4 to 6 percent slopes, eroded	40	60	----	----	20	30
Sharpsburg silty clay loam, 6 to 12 percent slopes, eroded	40	55	----	----	20	25
Sharpsburg silty clay loam, 6 to 12 percent slopes, severely eroded	35	50	----	----	15	20
Sharpsburg silty clay loam, 12 to 17 percent slopes, eroded	30	40	----	----	15	20
Sharpsburg silty clay loam, 12 to 17 percent slopes, severely eroded	25	35	----	----	10	15
Sharpsburg and Wymore silty clay loams, 2 to 4 percent slopes	40	60	----	----	25	35
Sharpsburg and Wymore silty clay loams, 4 to 6 percent slopes, eroded	40	55	----	----	20	30
Sharpsburg and Wymore silty clay loams, 6 to 12 percent slopes, eroded	30	40	----	----	20	25
Sharpsburg and Wymore silty clay loams, 6 to 12 percent slopes, severely eroded	25	40	----	----	15	20

See footnote at end of table.

crops under two levels of management

under a high level of management. Absence of yield indicates that the crop is not ordinarily grown on the soil]

Grain sorghum				Soybeans				Alfalfa				Tame pasture	
Dryland		Irrigated		Dryland		Irrigated		Dryland		Irrigated			
A	B	A	B	A	B	A	B	A	B	A	B	A	B
Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*AUM/ac.*[1]	*AUM/ac.*[1]
30	45			15	20			2.0	2.5			1.5	3.0
15	25							1.5	2.0			1.0	2.0
15	30							1.5	2.0			.6	1.5
												1.5	3.0
												1.2	3.0
25	35							1.5	2.5			1.5	3.0
20	30							1.5	2.0			1.2	2.0
15	25							1.5	2.0			1.0	1.5
50	65	70	85	20	25	35	40	3.0	4.0	4.5	5.5	2.0	6.0
30	45							2.0	3.0			1.5	3.0
50	65	70	85	20	25	35	45	2.5	3.5	3.5	5.5	1.7	4.0
55	75			20	25			3.5	4.5			3.0	6.0
50	65			15	20			3.0	3.5			3.0	6.0
30	40			15	20			1.5	2.0			1.7	3.0
35	55			15	20			2.0	3.0			1.3	3.0
20	35							1.5	2.5			1.0	2.0
50	65			20	25			2.0	3.0			3.0	6.0
50	65			20	25			2.0	3.0			1.5	3.0
55	75			20	30	30	40	3.5	4.5	4.0	5.5	2.0	6.0
45	65			15	20			2.5	3.5			3.0	6.0
30	45			10	15			1.5	2.5			2.0	3.0
50	75	70	85	20	30	35	45	3.5	4.5	4.0	5.5	3.0	6.0
												1.5	2.4
40	55	60	80	20	25	30	40	2.0	3.0	3.0	4.5	2.0	4.0
45	65			20	25			3.0	4.0			2.0	6.0
												1.3	2.0
35	50							2.0	3.0			1.5	3.0
												2.0	3.0
45	65			20	25			2.0	3.0			1.3	3.0
40	60			20	25			1.5	3.0			1.1	2.4
35	50							1.5	3.0			1.1	2.4
30	45							1.5	2.5			1.0	2.0
												1.0	2.0
35	50			10	15			1.5	3.0			1.1	2.4
												.9	1.3
35	55			15	20			2.0	3.0			1.3	3.0
20	35							1.5	2.5			1.0	2.0
55	70			25	35							3.0	6.0
60	80							3.0	4.0				
15	30							1.5	2.5			1.5	3.0
												1.1	1.5
30	45			15	20			2.0	2.5			1.3	3.0
15	25							1.5	2.0			1.2	2.4
15	30			5	10							2.0	4.0
												2.4	4.0
												1.3	2.4
												1.2	2.0
25	40	40	60					1.5	2.5			1.3	2.4
25	40	40	60	10	20	25	40	2.0	3.0	2.5	3.5	2.0	4.0
30	45	45	65	15	25	30	40	2.5	3.5	3.0	5.0	2.0	4.0
50	75	75	100	20	30	30	45	3.0	4.0	4.0	5.5	2.0	6.0
45	70	65	90	20	30	30	45	3.0	4.0	5.0	5.5	2.0	6.0
40	65			15	25			3.0	4.0			2.0	4.0
40	60			15	20			2.5	3.5			1.5	3.0
35	55							2.5	3.5			1.3	2.4
30	45							2.5	3.0			1.3	2.4
25	40							2.5	2.5			1.2	2.4
45	65			20	30			3.0	4.0			2.0	4.0
40	60			15	20			4.0	3.0			2.0	4.0
30	45							2.5	3.5			1.5	3.0
25	40							2.5	3.5			1.3	2.4

TABLE 2.—*Average acre yields of principal*

Soil	Corn				Wheat	
	Dryland		Irrigated			
	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Sharpsburg and Wymore silty clay loams, 12 to 17 percent slopes, eroded	20	35			10	15
Sharpsburg and Wymore silty clay loams, 12 to 17 percent slopes, severely eroded	20	35			10	15
Shelby and Burchard clay loams, 6 to 12 percent slopes	35	50			20	30
Shelby and Burchard clay loams, 6 to 12 percent slopes, eroded	30	45			20	25
Shelby and Burchard clay loams, 6 to 12 percent slopes, severely eroded	25	40			10	15
Steinauer clay loam, 12 to 30 percent slopes						
Volin silt loam	55	80	75	100	25	35
Wann fine sandy loam, moderately deep	35	50	55	75	10	20
Wann fine sandy loam, alkali						
Wann fine sandy loam, deep	45	60	65	80	15	25

[1] AUM/ac. stands for animal-unit month per acre and is the number of months that 1 cow can be grazed on 1 acre without damaging the pasture.

Management of Woodland [3]

The natural forest in Saunders County grows chiefly on the bluffs and first bottom of the Platte River, but it also fringes the smaller streams.

In the bluffy areas along the Platte River, bur oak and sumac originally grew on the upper slopes and hill crests (fig. 28). The lower slopes supported elm, ash, boxelder, bitternut hickory, hackberry, redcedar, and a scattering of black walnut, mulberry, and basswood. Much of this timber has been cleared, and the soils have been cultivated.

In the eastern and southeastern parts of the county, the trees are chiefly willow and cottonwood along the creeks in the first bottom of the Platte River, and there is a scattering of ash, elm, boxelder, hackberry, honeylocust, mulberry, black walnut, and redcedar. Cottonwood, willow, elm, and redcedar grow in areas adjoining the river and on islands in the channel.

In the southwestern corner of the county, bur oak, ash, and boxelder occupy the lower slopes along Oak Creek and Rock Creek and their tributaries. Bur oak is also found on the very steep slopes along the bluff line of Salt Creek in the southeastern corner of the county.

Native woodland has little value in the county because there are no wood-using industries and the demand for fuel wood is negligible. Some areas of bottom land could be profitably managed to produce valuable black walnut timber, but on the steeper slopes the chief value of trees is in controlling erosion and providing cover for wildlife.

Tree plantings

Trees are planted in Saunders County for establishing wind barriers to protect farmsteads, feedlots, and fields and for providing wildlife habitats, including living fences of multiflora rose. Many hedges of Osage-orange or black locust were planted on farm boundaries, but most of these have been removed. Trees are not difficult to establish in windbreaks if the sites are prepared properly and the trees are planted in a pattern that will accomplish the purpose for which the windbreak is planned.

[3] By SIDNEY S. BURTON, woodland specialist, Soil Conservation Service.

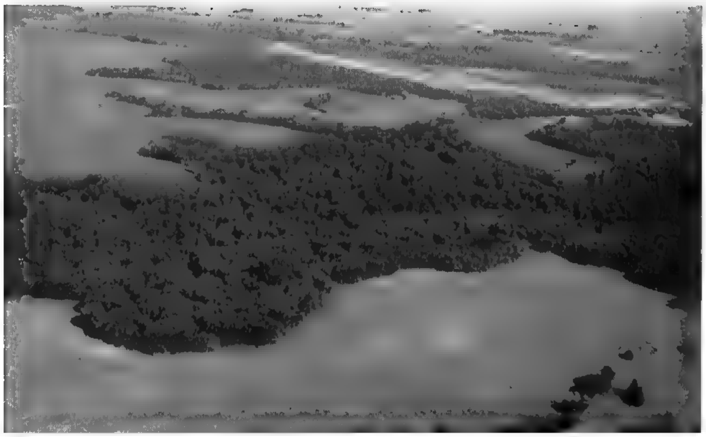

Figure 28.—**Native timber in bluffy areas along the Platte River in the northern part of the county.**

Site preparation.—The preparation needed for successful tree planting varies for different kinds of sites. On sites that were in grass or alfalfa, summer fallow is needed to store moisture, and all grass should be killed. Plowing in fall or spring and disking in spring is generally adequate for areas in stubble. For underplanting in wooded areas where the ground cover is heavy, an 18-inch spot should be scalped before each seedling is planted.

Farmstead and feedlot protection.—Windbreaks that protect farmsteads and feedlots in winter should be wide enough to hold most of the snow within the windbreaks. This requires 7 to 10 rows of trees. The rows should be north and west of the area to be protected, and not less than 100 feet from the main buildings.

These windbreaks will provide a satisfactory barrier if they consist of low, shrubby plants, medium-height trees, and tall trees. For adequate winter protection and longer life, at least 50 percent of the trees and other plants should be evergreens. Redcedar makes an ex-

crops under two levels of management—Continued

Grain sorghum				Soybeans				Alfalfa				Tame pasture	
Dryland		Irrigated		Dryland		Irrigated		Dryland		Irrigated			
A	B	A	B	A	B	A	B	A	B	A	B	A	B
Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*AUM/ac.*[1]	*AUM/ac.*[1]
25	40	----	----	----	----	----	----	2.5	3.0	----	----	1.3	2.4
20	35	----	----	----	----	----	----	2.0	2.5	----	----	1.2	2.4
35	50	----	----	20	25	----	----	2.5	3.5	----	----	1.5	3.0
30	45	----	----	----	----	----	----	2.5	3.5	----	----	1.5	3.0
25	40	----	----	----	----	----	----	2.0	3.0	----	----	1.3	2.4
----	----	----	----	----	----	----	----	----	----	----	----	1.0	1.5
60	80	75	100	25	35	35	50	3.5	4.5	4.0	6.0	3.0	6.0
35	50	55	75	15	20	25	35	1.5	2.5	3.0	5.0	2.0	4.0
45	60	65	80	15	20	25	35	2.5	3.5	3.5	5.5	3.0	4.0

cellent outside row because its foliage reaches almost to the ground.

A well-planned and carefully maintained windbreak provides many benefits that more than repay the planter for the expense and labor that goes into its establishment (fig. 29). Windbreaks prevent snow drifting in yards, prevent soil blowing, reduce winter fuel costs, provide shelter for livestock and thus reduce feed costs, protect gardens, and beautify the farm home.

Field windbreaks or shelterbelts.—The rough topography in Saunders County limits use of field windbreaks. In the more nearly level cultivated areas, however, the windbreaks help control soil blowing, increase soil moisture by holding snow on the fields, prevent damage to growing crops by strong winds, reduce evaporation, and furnish food and cover for wildlife.

To obtain these benefits, fields should be protected by a number of windbreaks spaced at regular intervals. Tree belts protect an area that extends from the barrier to a distance of about 20 times the height of the tallest trees. Wide belts are not needed to protect fields, and the narrow belts should consist of dense growing species that do not take moisture from the field. Belts of one to three rows, chiefly of redcedar and pine, are suitable.

***Figure 29.*—Windbreak protecting farm buildings.**

727-524—65——4

Because the soils of the county differ in their suitability for windbreaks and shelterbelts, they have been placed in seven windbreak suitability groups. These groups and the kinds of trees suitable for planting on soils of each group are listed in table 3. Riverwash has not been placed in a windbreak suitability group, because it is not suitable for planting trees.

Maintaining planted trees

To obtain the highest survival and reasonably fast growth, young plantings should be clean cultivated until the trees are large enough to shade competing weeds. This usually takes 5 or 6 years. Complete and permanent protection from livestock is necessary if a satisfactory wind barrier is to be maintained.

Management for Wildlife [4]

Saunders County supports may kinds of wildlife that contribute to its economy and recreation. Bobwhite (quail) are native to Saunders County and are important upland game. Pheasant, introduced into the area some years ago, are also important. Much of the recreational hunting in the county is for these two birds, and for migratory waterfowl and upland game animals such as squirrel and cottontail rabbit. Other rodents and birds, as well as furbearers and predators, are found in varying numbers. White-tailed deer are seen frequently in the rougher areas.

Many species of birds are highly beneficial because they eat harmful insects. Avian predators help to keep undesirable rodents within tolerable limits as do shrews, skunks, badgers, and other animals.

A considerable number of ponds in the county can furnish excellent fishing under proper management (fig. 30). The Platte River borders Saunders County on the north and east and provides aquatic and semiaquatic areas for wildlife requiring them.

Although the areas suitable for wildlife are considerable in Saunders County, more are needed so that wildlife

[4] By CHARLES V. BOHART, biologist, Soil Conservation Service.

TABLE 3.—*Windbreak suitability groups and species suitable for planting*

Windbreak group, soil series, and map symbols	Species suitable for planting		
	Shrubs	Conifers	Broad-leaved trees
Silty to Clayey group: Deep, well-drained soils that are silty, clayey, or have a claypan. Adair (AdC2, AdD2). Adair and Pawnee (APD3). Burchard and Shelby (BSE, BSE2, BSE3). Butler (Bt). Colo (Ct). Geary (GeC2, GeC3). Gullied land (GL). Hobbs (Hz). Judson (JtB). Made land (drainage ditch spoil banks) (ML). Malcolm (MnD2). Monona (MnC, MnC2, MnE, MnE2, MnF, MhC2, MhE2). Morrill (MrC2, MrC3). Muir (Mt). Pawnee (PwC2, PwD2). Sharpsburg (ShA, ShB, ShC2, ShD2, ShD3, ShE2, ShE3). Sharpsburg and Wymore (SWB, SWC2, SWD2, SWD3, SWE2, SWE3). Shelby and Burchard (SBD, SBD2, SBD3). Steinauer (StE). Volin (Vo).	Lilac, cotoneaster, honeysuckle, chokeberry, and multiflora rose.	Redcedar, Rocky Mountain juniper, Austrian pine, ponderosa pine, and Chinese arborvitae.	Mulberry, Russian-olive, green ash, hackberry, American elm, honeylocust, red oak, bur oak, wild black cherry, and Siberian elm.
Sandy group: Moderately sandy and nearly level, very sandy soils. Cass (Cs, 3Cs). Judson (JfB). Ortello (OrC2, OrE2). Sarpy (Sg, 4Sg).	American plum, cotoneaster, honeysuckle, and three-leaved sumac.	Redcedar, ponderosa pine, Scotch pine, and Chinese arborvitae.	Boxelder, mulberry, green ash, honeylocust, Siberian elm, and cottonwood.
Very Sandy group: Very sandy soils consisting of loose sand that cannot be safely cultivated. Sarpy (Sa, 2Sa). Made land (waste from gravel pits) (ML).	None	Redcedar and ponderosa pine.	None.
Moderately Wet group: Soils that are on bottom lands or benches or in upland depressions and are occasionally wet because of a high water table or flooding. Colo (2Ct). Fillmore (Fi). Lamoure (Lb). Leshara (Le, 3Le). Luton (Lu). Mixed alluvial land (Sx). Muck (Mk). Sarpy (2Sg). Wann (Wb, 3Wb).	Lilac, honeysuckle, cotoneaster, buffaloberry, dogwood, and purple willow.	Redcedar, Scotch pine, and Austrian pine.	Russian-olive, boxelder, diamond willow, golden willow, green ash, American elm, honeylocust, cottonwood, white willow, and Siberian elm.
Wetland group: Soils that are on bottom lands or benches or in upland depressions and are extremely wet because of flooding, a high water table, or poor drainage. Alluvial land (Sy). Barney (B2). Fillmore (2Fi). Rauville (Ra).	Purple willow and dogwood.	None	Diamond willow, golden willow, white willow, and cottonwood.

TABLE 3.—*Windbreak suitability groups and species suitable for planting*—Continued

Windbreak group, soil series, and map symbols	Species suitable for planting		
	Shrubs	Conifers	Broad-leaved trees
Moderately Saline-Alkali group: Moderately saline or alkali soils. Lamoure (2Lb). Leshara (2Le). Luton (2Lu). Wann (2Wb).	Buffaloberry, American plum, and dogwood.	Scotch pine	Russian-olive, diamond willow, green ash, cottonwood, Siberian elm, and honeylocust.
Shallow group: Shallow soil with a root zone limited by bedrock, shale, or dry gravel. Platte (Pt).	Three-leaved sumac	Redcedar	None.

production and the recreational and other benefits from it are increased. If properly used, soils of any capability class are suitable for production of wildlife.

Undisturbed areas require protection from burning and grazing. The brushy and grassy areas should be fenced. Areas around small ponds should be protected so that wildlife that get food and cover in these areas can increase.

Habitats for wildlife can be developed in the county by—

1. Managing farm ponds so that fish, waterfowl, and furbearers are increased. Appropriate plantings and fencing may be necessary.
2. Planting hedgerows across and around fields and establishing field borders of grasses and legumes.
3. Planting especially to supply food for wildlife.
4. Establishing wildlife cover where it is needed.

Technical assistance in carrying out this work is available from State and Federal agencies that are working to conserve wildlife.

***Figure 30.*—A farm pond properly stocked and managed is a pleasure.**

Use of Soils in Engineering [5]

Some soil properties are of special interest to engineers because these properties affect the construction and maintenance of highways, airports, pipelines, building foundations, earth dams for storing water and controlling erosion, systems for irrigation, drainage, and sewage disposal, and structures for conserving soil and water. Among those soil properties important to engineers are texture, permeability, shear strength, plasticity, moisture-density relations, compressibility, workability, and water-holding capacity. Also important are topography, depth to the water table and how much it fluctuates, and depth to bedrock or to sand and gravel.

The information in this report can be used to—

1. Make studies of soil and land use that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of engineering properties of soils in planning agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces and other structures for conserving soil and water.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting highway and airport locations and in planning a detailed soil survey for the intended locations.
4. Estimate the extent of drainage areas and the amount and speed of runoff so that these estimates can be used in designing culverts and bridges.
5. Identify the soils along a proposed highway route so that preliminary estimates can be made of the thickness required for flexible pavements.
6. Estimate the need for clay that will stabilize the surface of unpaved roads.
7. Locate deposits of sand, gravel, rock, mineral filler, and soil binder for use in subbase courses, base courses, and surface courses of flexible pavements for highways and airfields.
8. Make preliminary evaluations of topography, surface drainage, subsurface drainage, height of water table, and other features that may affect an area and the design of highway embankments, subgrades, and pavements.

[5] By LEE E. SMEDLEY, assistant State conservation engineer, Soil Conservation Service, and WILLIAM J. RAMSEY, geologist, Division of Materials and Tests, Nebraska Department of Roads. The work by the Department of Roads was performed under a cooperative agreement with the Bureau of Public Roads, U.S. Department of Commerce.

9. Correlate performance of engineering structures with soil mapping units and thus develop information that will be useful in designing and maintaining these structures.
10. Determine the suitability of soil units for cross-country movement of vehicles and construction equipment.
11. Supplement information obtained from other published maps and reports and from aerial photographs for the purpose of making soil maps and reports that can be used readily by engineers.

The engineering interpretations in this report are necessarily generalized. At many construction sites, the soil material varies greatly within the depth of proposed excavations. Also, several different soils may be found within short distances. *For these reasons the information in this report is not adequate for design and construction of specific engineering works, and further tests of soils sampled at the construction site are required.*

The maps, soil descriptions, and other data in this report are valuable in planning detailed engineering surveys. By using information in this report, the engineer can select the soil units and then concentrate on the ones most suitable for the kind of construction planned. Thus, a minimum number of soil samples will be needed for laboratory testing.

The terminology in this report is that used by agriculturists. Many of the terms have a special meaning to soil scientists and should, therefore, be defined for the engineer. Some of the more common terms are defined in the Glossary at the back of the report. The engineer should refer to the sections "Descriptions of the Soils" and "Formation and Classification of Soils." Much information in those sections is valuable in planning engineering work.

Engineering classification systems

Two systems of classifying soils, the AASHO and the Unified, are generally used by engineers and are used in this report. Most highway engineers classify soil materials in accordance with the AASHO system, which has been approved by the American Association of State Highway Officials (*1*).[6]

In this system soil materials are classified in seven principal groups. The groups range from A–1, consisting of gravelly soils of high bearing capacity, to A–7, which is made up of clay soils having low strength when wet. Within each group, the relative engineering value of the material is indicated by a group index number. The group index for the soil groups A–1 and A–3 is 0. The poorest soils in group A–2 have a group index number of 4; in group A–4, 8; in group A–5, 12; in group A–6, 16; and in group A–7, 20. The group index number is shown in parentheses for the soils tested in this county (see next to last column of table 4).

Many engineers prefer to use the Unified soil classification system (*12*). In this system the soils are identified according to their texture and plasticity and are grouped according to their performance as engineering construction materials. The system establishes 15 soil groups, which are divided as (1) coarse-grained soils (eight classes), (2) fine-grained soils (six classes), and (3) highly organic soils. These classes are designated by pairs of letters. Soils that have characteristics of two classes have a dual classification, for example, ML–CL. The classes range from GW, consisting of well-graded gravel and sand mixtures, both of which contain little or no fines, to Pt consisting of peat and other highly organic soils. The soils of this county have been classified only in the SP, SM, ML, CL, and CH classes and in the dual classes. The Unified system provides for a simple field method and a laboratory method for determining the amount and kind of basic constituents of the soils. Both methods are based on gradation and plasticity and vary only in degree of accuracy. The laboratory method uses mechanical analyses, liquid limit data, and plasticity index for an exact classification. For a more accurate classification of the fine-grained soils, the liquid limit and the plasticity index are plotted on a plasticity chart. The classification of the soils tested according to the Unified system is given in the last column of table 4.

[6] Italic numbers in parentheses refer to Literature Cited, p. 79.

Engineering test data

If the engineer is to make the best use of the soil survey report and its soil map, he should know the physical properties of the soil materials and the condition of the soil in place. After soil materials are tested and the behavior of soil in engineering structures and foundations is observed, the engineer can develop design recommendations for the soil units that are mapped.

Table 4 shows engineering test data for samples of 9 different soil types taken at 10 sampling sites. These samples were tested especially for this report, according to standard AASHO procedures. The tests were made by the Division of Materials and Tests, Nebraska Department of Roads. Each soil was sampled by natural horizons.

The soils listed in table 4 were sampled at one or more locations. The test data for a soil sampled in only one location indicate the engineering characteristics of the soil at that location. At locations other than the one where it was tested, a soil may differ considerably in characteristics that affect engineering. Even for those soils sampled in more than one location, the test data probably do not show the maximum range in characteristics of materials.

The engineering soil classifications in the last two columns of table 4 are based on data obtained by mechanical analysis and from tests made to determine liquid limits and plastic limits. The mechanical analysis data for each soil sample identified in table 4 were obtained by a combination of the sieve and hydrometer methods. Percentages of clay obtained by the hydrometer method should not be used in naming the textural classes of soils.

The tests for liquid limit and plastic limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition. Some silty and sandy soils are non-

plastic; that is, they do not become plastic at any moisture content.

Engineering properties of the soils

Table 5 gives a brief description of each soil in the county and estimates of properties that are significant to engineering. Other information about the soils can be found in the section "Descriptions of the Soils." Information on the geology of this county is under the heading "Parent Material" in the section "Formation and Classification of Soils."

The engineering test data in table 4, information taken from the soil survey report, and knowledge of the individual soils in the county were used as a basis for describing the soils in table 5, for estimating their physical properties, and for estimating the percentage of material passing the various sieves. The Unified and AASHO classifications were made by using this combined information.

The texture, or grain size, of any soil varies considerably, especially that of an alluvial soil. Consequently, it should not be assumed that all parts of a listed soil will be the same wherever it occurs, or that the engineering classification of all parts will be the same as those given in table 5.

The rate of surface runoff ranges from very slow to very rapid in the county. The soils are fine grained and have low infiltration rates. The variations in runoff rates, as shown in table 5, may reflect variations in slope, as well as variations in profile characteristics that affect runoff.

Permeability in table 5 refers to the rate that water moves through undisturbed soil material. Permeability depends largely on soil texture and structure. It is listed for each layer of soil in a range of inches per hour. This range can be stated in words as follows:

Inches per hour	*Rating*
0.05 to 0.20	Slow.
0.20 to 0.80	Moderately slow.
0.80 to 2.50	Moderate.
2.50 to 5.0	Moderately rapid.
5.0 to 10.0	Rapid.
More than 10.0	Very rapid.

Estimates for the available water capacity, expressed in inches of water per inch of soil depth, is the water available to plants. This water is held in the range between field capacity and the wilting point.

In general, the texture of a soil indicates its shrink-swell potential. In table 5 the shrink-swell potential has been estimated as *high* for plastic silts and clays, as *none* for nonplastic soils that have no shrink-swell potential, and as *low* or *moderate* for intermediate soils containing less silt and clay and having a low or moderate plasticity index. Some of these soils, however, were rated low or moderate after they had been compared with soils of known mechanical analysis or plasticity ratings.

Only in the alkali Lamoure and Wann soils are there enough salts to affect the use of soils in construction. These alkali soils are in such small areas that alkalinity is not considered a problem in the county. Also, dispersion is not a problem, because only a few small areas of these alkali soils contain enough sodium salts to have moderate dispersion.

Engineering interpretation of the soils

Table 6 is an interpretation that will help engineers and others plan the use of soils in construction and in agricultural practices. It gives the Unified and AASHO classifications of soil material in the surface soil, subsoil, and substratum. The soils are rated in table 6 according to their suitability as a source of topsoil, sand, and sand and gravel. They are also rated according to their suitability for use as road subgrade and road fill. In addition, soil features are named that affect highway location, foundations, and the construction and maintenance of dikes, levees, low dams, and other structures. Also listed for the soils are features that affect drainage and other agricultural practices.

The ratings in table 6 for suitability of soil material for topsoil, sand, and sand and gravel apply only to Saunders County. As a source of topsoil, many of the soils are rated *poor* or *fair* because they are eroded, are low in natural fertility or in content of organic matter, or their surface layer is heavy, sticky, and difficult to handle. Even though a soil is rated *good* as a suitable source of sand or gravel, extensive exploration may be required to find material that has the gradation needed for the use intended.

Ratings are listed for suitability of the soils as road subgrade for paved roads (bituminous or concrete) and for gravel roads. Because properly confined sand is the best subgrade for paved roads, the soil material is rated *good*, if the AASHO classification is A–1 or A–3; *good to fair*, if A–2; *fair to poor*, if A–4; and *poor*, if A–6 or A–7–6.

The ratings for gravel roads refer to the part of the subgrade that receives the gravel surfacing. Since sand is noncohesive, it does not provide a stable surface. Rated *poor*, therefore, are all soils classified A–1 or A–3 and those classified A–2 that are not adequately plastic. Soils classified A–4 and those classified A–2 that are adequately plastic are rated *good to fair*. Silty or clayey soils that are classified A–5, A–6, or A–7–6 are rated *good* because they are acceptable for use in the upper part of the subgrade, which is surfaced with gravel.

The ratings for road fill are based on about the same criteria as the ratings for subgrade under bituminous or concrete pavement. Some ratings for paved and gravel roads and for road fill are ranges, for example, good to fair, because the soil in the profile varies.

Generally, soil features are rated according to the extent of the problems they might cause in the construction and maintenance of highways and agricultural structures and in carrying out agricultural practices. In table 6 the soil features that affect structures and practices were named after the profile characteristics shown in table 5 were considered. Because some soils have variations in their profile, the ratings of those soils may differ from place to place.

In listing soil features that affect highway location, most soils are rated for susceptibility to frost action. These ratings were made on the basis of the texture of the surface soil and subsoil. Clays and silts are susceptible to frost action if the underlying soil layers are pervious enough for water to rise and form ice lenses.

Soils for which the results of complete mechanical analyses are available are rated for susceptibility to frost action according to data in "Control of Soils in Military Construction, TM 5–541" (*11*). For soils having 64 percent or more of the surface soil consisting of grains between 0.074 and 0.005 millimeter in size, susceptibility to frost action is *very high* if less than 44 percent of the subsoil consists of grains finer than 0.005 millimeter and

TABLE 4.—*Engineering*

Soil name	Nebr. Dept. of Roads report No.	Depth	Horizon	Specific gravity	Mechanical analysis [2] Percentage passing sieve— No. 10 (2.0 mm.)	Mechanical analysis [2] Percentage passing sieve— No. 40 (0.42 mm.)
		Inches				
Adair clay loam: 0.14 mile N. and 100 feet E. of SW. cor., sec. 14, T. 13 N., R. 5 E.	S-62-3163	0-15	A	2. 63	100	98
	S-62-3164	15-42	B	2. 67	100	98
	S-62-3165	42-60	D	2. 67	100	95
Burchard silty clay loam: 350 feet W. and 50 feet N. of SE. cor., sec. 28, T. 13 N., R. 5 E.	S-62-3172	0-12	A	2. 56	100	95
	S-62-3173	12-28	B	2. 63	100	94
	S-62-3174	28-48	C	2. 65	100	95
Butler silty clay loam: 0.1 mile N. and 75 feet W. of SE. cor., sec. 12, T. 14 N., R. 7 E.	S-62-3146	0-18	A	2. 51	-----	-----
	S-62-3147	18-40	B	2. 62	-----	100
	S-62-3148	40-60	C	2. 65	-----	-----
Colo silty clay loam: 125 feet E. and 75 feet N. of SW. cor., SE¼ sec. 11, T. 14 N., R. 7 E.	S-62-3161	0-18	A	2. 58	-----	100
	S-62-3162	18-48	C	2. 63	-----	100
Leshara silt loam: 300 feet E. and 60 feet S. of NW. cor., sec. 25, T. 13 N., R. 9 E.	S-62-3149	0-10	A	2. 58	-----	-----
	S-62-3150	10-50	C	2. 65	-----	-----
	S-62-3151	50-80	D	2. 62	-----	-----
Monona silt loam: 0.3 mile E. and 0.2 mile S. of NW. cor., sec. 12, T. 16 N., R. 8 E.	S-62-3152	0-8	A	2. 60	-----	-----
	S-62-3153	8-36	B	2. 66	-----	-----
	S-62-3154	36-60	C	2. 67	-----	-----
Muir silty clay loam: 0.3 mile S. and 75 feet E. of NW. cor., sec. 22, T. 13 N., R. 5 E.	S-62-3166	0-14	A	2. 59	-----	-----
	S-62-3167	14-32	B	2. 65	-----	-----
	S-62-3168	32-60	D	2. 67	-----	-----
Shelby clay loam: 0.12 mile E. and 80 feet S. of NW. cor., sec. 34, T. 13 N., R. 5 E.	S-62-3169	0-6	A	2. 63	[6]87	81
	S-62-3170	6-40	B	2. 67	100	96
	S-62-3171	40-60	C	2. 69	100	97
Sharpsburg silty clay loam: 175 feet E. and 100 feet S. of NW. cor., sec. 27, T. 14 N., R. 7 E.	S-62-3158	0-13	A	2. 56	-----	-----
	S-62-3159	13-44	B	2. 63	-----	-----
	S-62-3160	44-60	C	2. 69	-----	-----
900 feet N. and 80 feet E. of NW¼ cor., sec. 17, T. 16 N., R. 6 E. (minimal).	S-62-3155	0-5	A	2. 58	-----	-----
	S-62-3156	5-30	B	2. 63	-----	-----
	S-62-3157	30-60	C	2. 63	-----	-----

[1] Tests performed by the Nebraska Department of Roads in cooperation with Bureau of Public Roads, U.S. Department of Commerce, in accordance with standard procedures of the American Association of State Highway Officials (AASHO).

[2] Mechanical analyses according to AASHO Designation T 88. Results by this procedure frequently may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fraction. The mechanical analyses used in this table are not suitable for naming textural classes of soils.

test data [1]

Mechanical analysis [2]—Continued						Liquid limit	Plasticity index	Classification	
Percentage passing sieve—Continued		Percentage smaller than—						AASHO [3]	Unified [4]
No. 60 (0.250 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
96	93	84	56	37	31	42	20	A-7-6(12)	CL.
96	89	81	56	40	35	47	21	A-7-6(14)	ML-CL.
90	80	70	57	41	36	57	36	A-7-6(19)	CH.
89	78	64	47	29	23	44	17	A-7-6(12)	ML-CL.
89	76	68	56	40	33	48	26	A-7-6(16)	CL.
89	77	69	57	39	31	46	26	A-7-6(16)	CL.
100	99	90	56	29	20	42	12	A-7-5(9)	ML.
99	98	95	78	40	38	47	27	A-7-6(16)	CL.
100	98	92	61	41	33	50	28	A-7-6(17)	CL.
99	91	85	61	39	31	46	21	A-7-6(14)	ML-CL.
95	79	68	47	30	26	39	21	A-6(12)	CL.
100	97	91	35	18	12	33	7	A-4(8)	ML.
100	94	63	17	8	6	25	[5] NP	A-4(8)	ML.
100	96	90	54	33	29	49	28	A-7-6(17)	CL.
100	98	88	42	25	20	37	13	A-6(9)	ML-CL.
100	99	89	59	36	30	48	23	A-7-6(15)	CL.
----------	100	90	54	34	28	45	23	A-7-6(14)	CL.
100	98	90	56	32	26	41	17	A-7-6(11)	ML-CL.
100	99	92	62	38	33	48	24	A-7-6(15)	CL.
100	99	94	69	41	37	53	32	A-7-6(19)	CH.
77	65	56	35	20	13	38	17	A-6(9)	CL.
92	74	65	50	36	31	44	21	A-7-6(13)	CL.
91	77	68	52	38	32	46	27	A-7-6(16)	CL.
100	99	93	62	40	32	45	19	A-7-6(13)	ML-CL.
----------	100	92	65	45	39	52	32	A-7-6(18)	CH.
----------	100	85	56	35	31	47	27	A-7-6(16)	CL.
100	99	91	59	37	31	43	20	A-7-6(13)	CL.
100	99	92	58	40	34	53	30	A-7-6(19)	CH.
100	99	92	58	36	30	47	26	A-7-6(16)	CL.

[3] Based on Standard Specification for Highway Materials and Methods of Sampling and Testing (Pt. 1, Ed. 8): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, AASHO Designation M 145-49.

[4] Based on the Unified Soil Classification System, Tech. Memo. No. 3-357, v. 1, Waterways Experiment Station, Corps of Engin., March 1953, rev. 1957. The Soil Conservation Service and Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within 2 points from the A-line are to be given a borderline classification.

[5] NP stands for nonplastic.

[6] In this sample of Shelby clay loam, 89 percent passes the No. 4 (4.76 mm.) sieve; 92 percent, the 3/8-inch sieve; 93 percent, the 3/4-inch sieve; 93 percent, the 1-inch sieve; and 100 percent, the 1 1/2-inch sieve.

TABLE 5.—*Description of the soils*

[Absence of data indicates that characteristics vary

Map symbol	Soil	Description of soil and site					Depth from surface
		Position	Parent material	Surface runoff	Depth to water table	Depth to sand or sand and gravel	
					Feet	*Feet*	*Inches*
AdC2	Adair clay loam, 6 to 9 percent slopes, eroded.[1]	Upland.	Outwash from till.	Moderate to rapid.	(2)	(3)	0 to 15 15 to 31 31 to 66
AdD2	Adair clay loam, 9 to 12 percent slopes, eroded.						
APD3	Adair and Pawnee soils, 6 to 12 percent slopes, severely eroded.[4]						
Sy	Alluvial land.	Nearly level bottom land.	Silty alluvium.	Slow.	4 to 20	(3)	------------
B2	Barney soils.	Nearly level bottom land.	Sandy alluvium.	Slow.	1 to 5	2 to 5	0 to 14 14 to 26 26 to 36
BSE	Burchard and Shelby clay loams, 12 to 17 percent slopes.[5]	Upland.	Till.	Rapid.	(2)	(3)	0 to 9
BSE2	Burchard and Shelby clay loams, 12 to 17 percent slopes, eroded.[1]						9 to 24
BSE3	Burchard and Shelby clay loams, 12 to 17 percent slopes, severely eroded.						24 to 60
Bt	Butler silty clay loam.	Upland depressions.	Peorian loess.	Slow.	(2)	(3)	0 to 13 13 to 50 50 to 62+
Cs	Cass fine sandy loam, moderately deep.	Nearly level bottom land.	Sandy alluvium.	Slow.	5 to 10	1.5 to 3	0 to 20 20 to 24 24+
3Cs	Cass fine sandy loam, deep.	Nearly level bottom land.	Sandy alluvium.	Slow.	5 to 15	3 to 10	0 to 29 29 to 49 49 to 60
Ct	Colo silty clay loam.	Nearly level bottom land.	Moderately clayey alluvium.	Slow.	4 to 10	5 to 25	0 to 14
2Ct	Colo silty clay loam, clayey substratum.						14 to 26 26 to 48
Fi	Fillmore silty clay loam.	Upland depressions.	Peorian loess.	Very slow.	(2)	(3)	0 to 8
2Fi	Fillmore silty clay loam, ponded.						8 to 14 14 to 56
GeC2	Geary silty clay loam, 6 to 12 percent slopes, eroded.	Upland.	Loveland loess.	Moderate.	(2)	(3)	0 to 30 30 to 54
GeC3	Geary silty clay loam, 6 to 12 percent slopes, severely eroded.[6]						
GL	Gullied land.	Upland.	Loess and till.	Rapid.	(2)	(3)	------------
Hz	Hobbs soils.	Nearly level bottom land.	Silty alluvium.	Slow.	6 to 15	6 to 20	0 to 13 13 to 26 26 to 40

See footnotes at end of table.

and estimates of their physical properties

and that classification and properties were not estimated]

Classification			Percentage passing sieve—			Permeability	Available water capacity	Shrink-swell potential
USDA	Unified	AASHO	No. 4	No. 10	No. 200			
						Inches per hour	*Inches per inch of soil*	
Silty clay loam	CL	A-6 or A-7-6		100	85–95	0. 20–0. 80	0. 17	Moderate.
Silty clay	CL or CH	A-6 or A-7-6		100	85–95	0. 05–0. 20	. 18	Moderate to high.
Clay loam	CL or CH	A-6 or A-7-6		100	75–95	0. 20–0. 80	. 17	High.
Fine sandy loam	SM	A-2 or A-4	100	95–100	30–49	2. 5 –5. 0	. 14	Low.
Loamy sand	SM	A-2	100	75–95	15–35	2. 5 –5. 0	. 08	None to low.
Fine sand and coarse sand.	SP to SM	A-3 or A-2	90–100	65–95	0–10	10. 0+	. 07	None.
Clay loam	CL	A-7-6		100	75 95	0. 20–0. 80	. 17	Moderate.
Clay loam	CL or CH	A-7-6		100	75–95	0. 20–0. 80	. 17	Moderate to high.
Clay loam	CL or CH	A-7-6		100	75–95	0. 20–0. 80	. 17	Moderate to high.
Silty clay loam	ML or CL	A-6 or A-7-6		100	95–100	0. 20–0. 80	. 17	Moderate.
Silty clay	CL or CH	A-6 or A-7-6		100	95–100	0. 05–0. 20	. 18	Moderate to high.
Silty clay loam	CL	A-6 or A-7-6		100	95–100	0. 20–0. 80	. 17	Moderate.
Fine sandy loam	SM	A-2 or A-4	100	95–100	30–49	2. 5 –5. 0	. 15	Low.
Loamy sand	SM	A-2	100	75–95	15–35	5. 0 –10. 0	. 08	None to low.
Coarse sand and fine gravel.	SP to SM	A-3	90–100	65–95	0–10	10. 0+	. 06	None.
Fine sandy loam	SM	A-2 or A-4	100	95–100	30–49	2. 5 –5. 0	. 15	Low.
Loamy very fine sand.	SM	A-2 or A-4	100	85–100	35–49	2. 5 –5. 0	. 10	Low.
Coarse sand and fine gravel.	SP to SM	A-3 or A-2	90–100	65–95	0–10	10. 0+	. 06	None.
Silty clay loam	CL	A-6 or A-7-6		100	95–100	0. 20–0. 80	. 17	Moderate.
Silty clay	CL or CH	A-7-6		100	90–100	0. 05–0. 20	. 18	High.
Silty clay loam	CL	A-6 or A-7-6		100	95–100	0. 20–0. 80	. 17	Moderate.
Silty clay loam	CL	A-6 or A-7-6		100	95–100	0. 20–0. 80	. 17	Moderate.
Silty loam	ML to CL	A-4		100	90–100	0. 80–2. 5	. 16	Low to moderate.
Silty clay	CL or CH	A-7-6		100	95–100	0. 05–0. 20	. 18	Moderate to high.
Silty clay loam	CL or CH	A-6 or A-7-6		100	95–100	0. 20–0. 80	. 17	Moderate to high.
Clay loam	CL	A-6 or A-7-6		100	75–95	0. 20–0. 80	. 17	Moderate.
Silt loam	ML to CL	A-4 or A-6		100	90–100	0. 80–2. 5	. 16	Low to moderate.
Silty clay loam	CL	A-6		100	95–100	0. 20–0. 80	. 17	Moderate.
Silt loam	ML or CL	A-4 or A-6		100	90 100	0. 80–2. 5	. 16	Low to moderate.

TABLE 5.—*Description of the soils*

Map symbol	Soil	Description of soil and site: Position	Parent material	Surface runoff	Depth to water table	Depth to sand or sand and gravel	Depth from surface
					Feet	*Feet*	*Inches*
JfB	Judson fine sandy loam, 2 to 6 percent slopes.	Gently sloping foot slopes.	Colluvial-alluvial silts.	Moderate.	10 to 40	(3)	0 to 14 14 to 40
JtB	Judson silty clay loam, 2 to 6 percent slopes.	Gently sloping foot slopes.	Colluvial-alluvial silts.	Moderate.	10 to 40	(3)	0 to 56
Lb 2Lb	Lamoure silty clay loam.[1] Lamoure silty clay loam, alkali.	Nearly level bottom land.	Moderately clayey alluvium.	Slow.	2 to 4	5 to 15	0 to 42
Le 2Le	Leshara silt loam, deep.[1] Leshara silt loam, alkali.	Nearly level bottom land.	Silty alluvium.	Slow.	3 to 5	5 to 15	0 to 52
3Le	Leshara silt loam, moderately deep.	Nearly level bottom land.	Silty alluvium.	Slow.	3 to 5	5 to 15	0 to 24 24+
Lu 2Lu	Luton clay.[1] Luton soils, saline.	Nearly level bottom land.	Clayey alluvium.	Slow.	4 to 10	6 to 20	0 to 6 6 to 32 32 to 48
ML	Made land.	Bottom land.	(5)	(5)	(5)	(5)	(5)
MnD2	Malcolm silt loam, 6 to 12 percent slopes, eroded.	Upland.	Aftonian silts and sands.	Moderate.	(2)	(3)	0 to 8 8 to 30 30 to 60
Sx	Mixed alluvial land.	Nearly level bottom land.	Mixed alluvium.	Slow.	2 to 4	2 to 15	-----------
MnC MnC2 MnE MnE2 MnF MhC2	Monona silt loam, 6 to 12 percent slopes.[1] Monona silt loam, 6 to 12 percent slopes, eroded. Monona silt loam, 12 to 17 percent slopes. Monona silt loam, 12 to 17 per-slopes, eroded. Monona silt loam, 17 to 30 percent slopes. Monona silt loam, sand substratum, 6 to 12 percent slopes, eroded.	Upland.	Peorian loess.	Medium to rapid.	(2)	(3)	0 to 8 8 to 36 36 to 60
MhE2	Monona silt loam, sand substratum, 12 to 30 percent slopes, eroded.[1]	Upland.	Peorian loess.	Medium to rapid.	(2)	(3)	0 to 19 19 to 32 32 to 62+
MrC2 MrC3	Morrill clay loam, 6 to 12 percent slopes, eroded.[1] Morrill clay loam, 6 to 12 percent slopes, severely eroded.	Upland.	Till outwash.	Medium to rapid.	(2)	5 to 8	0 to 9 9 to 40 40 to 60
Mk	Muck.	Nearly level bottom land.	Peat and silty alluvium.	Slow.	2 to 4	5 to 15	0 to 48
Mt	Muir silty clay loam.	Nearly level bottom land.	Silty alluvium.	Slow.	6 to 15	10 to 20	0 to 36 36 to 60
OrC2 OrE2	Ortello complex, 6 to 12 percent slopes, eroded.[1] Ortello complex, 12 to 17 percent slopes, eroded.	Terrace.	Mixed alluvium.	Medium.	(2)	3 to 10	0 to 24 24 to 34 34 to 60

See footnotes at end of table.

and estimates of their physical properties—Continued

Classification			Percentage passing sieve—			Permeability	Available water capacity	Shrink-swell potential
USDA	Unified	AASHO	No. 4	No. 10	No. 200			
						Inches per hour	*Inches per inch of soil*	
Fine sandy loam	SM	A-4		100	36–49	2. 5 –5. 0	0. 15	Low.
Silty clay loam	CL	A-6		100	95–100	0. 20–0. 80	. 17	Moderate.
Silty clay loam	CL	A-6		100	95–100	0. 20–0. 80	. 17	Moderate.
Silty clay loam	CL or CH	A-6 or A-7-6		100	95–100	0. 20–0. 80	. 17	Moderate to high.
Silt loam	ML to CL	A-4, A-6, or A-7-6.		100	90–100	0. 80–2. 5	. 16	Low to high.
Silt loam	ML to CL	A-4, A-6, or A-7-6.		100	90–100	0. 80–2. 5	. 16	Low to moderate.
Medium sand	SP to SM	A-3	100	90–100	0–10	5. 0 –10. 0	. 07	None.
Silty clay	CH	A-7-6		100	95–100	0. 05–0. 20	. 18	High.
Clay	CH	A-7-6		100	95–100	0. 05–0. 20	. 18	High.
Silty clay	CH	A-7-6		100	95–100	0. 05–0. 20	. 18	High.
[5]	[5]	[5]	[5]	[5]	[5]	[5]	[5]	[5]
Silt loam	ML to CL	A-4		100	90–100	0. 80–2. 5	. 16	Low to moderate.
Silty clay loam	CL	A-6		100	95–100	0. 20–0. 80	. 17	Moderate.
Loamy very fine sand.	SM	A-2 or A-4		100	30–49	2. 5 –5. 0	. 10	None to low.
Silt loam	ML to CL	A-6 or A-7-6		100	90–100	0. 80–2. 5	. 16	Moderate.
Silt loam	CL	A-6 or A-7-6		100	90–100	0. 80–2. 5	. 16	Moderate.
Silt loam	CL	A-6 or A-7-6		100	90–100	0. 80–2. 5	. 16	Moderate.
Silt loam	ML to CL	A-6 or A-7-6		100	90–100	0. 80–2. 5	. 16	Low to moderate.
Very fine sandy loam.	SM	A-4		100	35–49	0. 80–2. 5	. 16	Low.
Fine sand and medium sand.	SP or SM	A-2 or A-3		100	0–15	5. 0 –10. 0	. 06	None.
Loam	ML to CL	A-4 or A-6		100	60–90	0. 80–2. 5	. 16	Low to moderate.
Clay loam	CL or CH	A-6 or A-7-6		100	75–95	0. 20–0. 80	. 17	Moderate.
Sandy loam	SM	A-2 or A-4	95–100	75–100	5–49	2. 5 –5. 0	. 06–0. 15	Low.
Silt loam	ML to CL	A-4 or A-7-6		100	90–100	0. 80–2. 5	. 16	Low to moderate.
Silty clay loam	CL	A-7-6		100	95–100	0. 20–0. 80	. 17	Moderate.
Silty clay	CL or CH	A-7-6		100	95–100	0. 05–0. 20	. 18	Moderate to high.
Loam	ML to CL	A-4 or A-6		100	60–85	0. 80–2. 5	. 16	Low to moderate.
Fine sand	SM	A-4		100	35–49	2. 50–5. 0	. 15	None to low.
Fine sand	SP to SM	A-3 or A-2	95–100	75–100	5–15	10. 0+	. 07	None.

TABLE 5.—*Description of the soils*

Map symbol	Soil	Description of soil and site: Position	Parent material	Surface runoff	Depth to water table	Depth to sand or sand and gravel	Depth from surface
					Feet	*Feet*	*Inches*
PwC2	Pawnee clay loam, 6 to 9 percent slopes, eroded.[1]	Upland.	Till.	Rapid.	(2)	(3)	0 to 10 10 to 32 32 to 42+
PwD2	Pawnee clay loam, 9 to 12 percent slopes, eroded.						
Pt	Platte loam.	Nearly level bottom land.	Mixed alluvium.	Slow.	2 to 5	1 to 1.5	0 to 9 9 to 16 16+
Ra	Rauville soils.	Nearly level bottom land.	Silty and clayey alluvium.	Slow.	1 to 3	5 to 20	0 to 16 16 to 34 34 to 48+
Rw	Riverwash.	Nearly level bottom land.	Sandy alluvium.	Slow.	0 to 3	0 to 3	-----------
Sa	Sarpy fine sand.[1]	Nearly level bottom land.	Sandy alluvium.	Slow.	4 to 10	3 to 10	0 to 36
2Sa	Sarpy fine sand, hummocky.						
Sg	Sarpy loamy fine sand.[1]	Nearly level bottom land.	Sandy alluvium.	Slow.	3 to 5	3 to 10	0 to 14 14 to 40 40+
2Sg	Sarpy loamy fine sand, imperfectly drained.						
4Sg	Sarpy loamy fine sand, loamy substratum.						
ShA	Sharpsburg silty clay loam, 0 to 2 percent slopes.	Upland.	Peorian loess.	Slow to rapid.	(2)	(3)	0 to 13 13 to 44 44 to 60
ShB	Sharpsburg silty clay loam, 2 to 4 percent slopes.[1]						
ShC2	Sharpsburg silty clay loam, 4 to 6 percent slopes, eroded.						
ShD2	Sharpsburg silty clay loam, 6 to 12 percent slopes, eroded.						
ShD3	Sharpsburg silty clay loam, 6 to 12 percent slopes, severely eroded.						
ShE2	Sharpsburg silty clay loam, 12 to 17 percent slopes, eroded.						
ShE3	Sharpsburg silty clay loam, 12 to 17 percent slopes, severely eroded.						
SWB	Sharpsburg and Wymore silty clay loams, 2 to 4 percent slopes.						
SWC2	Sharpsburg and Wymore silty clay loams, 4 to 6 percent slopes, eroded.[1] [7]	Upland.	Peorian loess.	Moderately slow to rapid.	(2)	(3)	0 to 6 6 to 26 26 to 60
SWD2	Sharpsburg and Wymore silty clay loams, 6 to 12 percent slopes, eroded.						
SWD3	Sharpsburg and Wymore silty clay loams, 6 to 12 percent slopes, severely eroded.						
SWE2	Sharpsburg and Wymore silty clay loams, 12 to 17 percent slopes, eroded.						
SWE3	Sharpsburg and Wymore silty clay loams, 12 to 17 percent slopes, severely eroded.						

See footnotes at end of table.

and estimates of their physical properties—Continued

Classification			Percentage passing sieve—			Permeability	Available water capacity	Shrink-swell potential
USDA	Unified	AASHO	No. 4	No. 10	No. 200			
						Inches per hour	*Inches per inch of soil*	
Clay loam	CL or CH	A-6 or A-7-6		100	75-95	0. 20-0. 80	0. 17	Moderate to high.
Clay	CH	A-7-6		100	85-95	0. 05 0. 20	. 18	High.
Clay loam	CH	A-7-6		100	75-95	0. 20-0. 80	. 17	High.
Loam	ML or CL	A-4 or A-6		100	60-85	0. 80-2. 5	. 16	Low to moderate.
Fine sandy loam	SM	A-2	95-100	85-95	20-35	2. 5 -5. 0	. 15	None to low.
Sand and gravel	SP to SM	A-3	90-95	75-85	0-10	10. 0+	. 06	None.
Silty clay loam	CL or CH	A-6 or A-7-6		100	95-100	0. 20-0. 80	. 17	Moderate to high.
Silty clay loam	CL or CH	A-6 or A-7-6		100	95-100	0. 20-0. 80	. 17	Moderate to high.
Silty clay	CL or CH	A-7-6		100	95-100	0. 05-0. 20	. 18	Moderate to high.
Fine sand	SP or SM	A-3 or A-2	100	99	0-15	5. 0 -10. 0	. 06	None.
Loamy sand	SM	A-2	100	80-100	10-30	2. 5 -5. 0	. 08	Low.
Fine sand	SP to SM	A-3 to A-2	100	90-100	0-15	5. 0 -10. 0	. 07	Low.
Sand and gravel	SP	A-3 or A-2	90-95	75-85	0-5	10. 0+	. 06	Low.
Silty clay loam	CL	A-7-6		100	95-100	0. 20-0. 80	. 17	Moderate.
Silty clay loam	CH	A-7-6		100	95-100	0. 05-0. 20	. 18	High.
Silty clay loam	CL	A-7-6		100	95-100	0. 20-0. 80	. 17	Moderate to high.
Silty clay loam	CL	A-6 or A-7-6		100	95-100	0. 20-0. 80	. 17	Moderate.
Silty clay	CH	A-7-6		100	95-100	0. 05-0. 20	. 18	High.
Silty clay loam	CL or CH	A-6 or A-7-6		100	95-100	0. 20-0. 80	. 17	Moderate to high.

TABLE 5.—*Description of the soils*

Map symbol	Soil	Description of soil and site: Position	Parent material	Surface runoff	Depth to water table	Depth to sand or sand and gravel	Depth from surface
					Feet	*Feet*	*Inches*
SBD SBD2 SBD3	Shelby and Burchard clay loams, 6 to 12 percent slopes.[8] Shelby and Burchard clay loams, 6 to 12 percent slopes, eroded.[1] Shelby and Burchard clay loams, 6 to 12 percent slopes, severely eroded.	Upland.	Till.	Medium.	(2)	(3)	0 to 10 10 to 35 35 to 50
StE	Steinauer clay loam, 12 to 30 percent slopes.	Upland.	Till.	Rapid to very rapid.	(2)	(3)	0 to 36
Vo	Volin silt loam.	Nearly level bottom land.	Silty alluvium.	Slow.	6 to 15	10 to 20	0 to 43
Wb	Wann fine sandy loam, moderately deep.	Nearly level bottom land.	Mixed alluvium.	Slow.	3 to 5	1.5 to 3	0 to 30 30+
3Wb 2Wb	Wann fine sandy loam, deep. Wann fine sandy loam, alkali.[1]	Nearly level bottom land.	Mixed alluvium.	Slow.	3 to 5	5 to 10	0 to 37 37 to 50 50+

[1] Classification and properties shown are those for this phase. Soils in this group are nearly uniform in properties listed, except for runoff and as indicated by the soil name, slope, degree of erosion, or alkalinity (in very small areas). The range given for runoff covers all the slope and erosion phases listed.

[2] Extremely deep water table.

[3] In most places sand or sand and gravel do not occur, or are at a depth below 20 feet.

[4] Except for runoff and a thinner surface layer, classification and properties for Adair part of these soils are the same as for Adair clay loams. See Pawnee clay loams for approximate properties of Pawnee part of these soils.

TABLE 6.—*Engineering*

Soil series and map symbols	Engineering classification: Unified	AASHO	Suitability for—: Topsoil	Sand	Sand and gravel	Subgrade of paved road	Subgrade of gravel road	Road fill	Soil features affecting—: Highway location
Adair (AdC2, AdD2).	CL in surface soil over CL or CH in subsoil, and substratum.	A-6 or A-7-6 in surface soil, subsoil, and substratum.	Fair	(1)	(1)	Poor	Good	Poor	Moderate to high susceptibility to frost action; erodible slopes.
Adair and Pawnee (APD3).	CL or CH in surface soil, subsoil and substratum.	A-6 or A-7-6 in surface soil, subsoil, and substratum.	Poor	(1)	(1)	Poor	Good	Poor	Moderate to high susceptibility to frost action; erodible slopes.
Alluvial land (Sy).	(3)	(3)	Good	(1)	(1)	(3)	(3)	(3)	Water table rises to within 5 feet of surface in some areas and may undermine pavement unless a fill is used.

See footnotes at end of table.

and estimates of their physical properties—Continued

Classification			Percentage passing sieve—			Permeability	Available water capacity	Shrink-swell potential
USDA	Unified	AASHO	No. 4	No. 10	No. 200			
						Inches per hour	*Inches per inch of soil*	
Clay loam	CL	A-6 or A-7-6	85-90	85-90	60-70	0.20-0.80	0.17	Moderate.
Clay loam	CL or CH	A-6 or A-7-6		100	75-85	0.20-0.80	.17	Moderate to high.
Clay loam	CL or CH	A-6 or A-7-6		100	70-85	0.20-0.80	.17	Moderate to high.
Clay loam	CL or CH	A-6 or A-7-6	95-100	90-100	70-90	0.20-0.80	.17	Moderate.
Silt loam	ML to CL	A-4 or A-6		100	90-100	0.80-2.5	.16	Low to moderate.
Fine sandy loam	SM	A-4	95-100	85-100	30-49	2.5-5.0	.15	Low.
Sand and gravel	SP	A-3 or A-2	90-100	65-95	0-4	10.0+	.06	None.
Fine sandy loam	SM	A-4	100	95-100	30-49	2.5-5.0	.15	Low.
Loamy sand	SM	A-2	100	80-100	13-30	2.5-5.0	.08	None.
Fine sand and medium sand.	SP	A-3 or A-2	95-100	90-100	0-4	5.0-10.0	.07	None.

[5] Data are for the Burchard soils. See Shelby and Burchard clay loams for data on Shelby soils.

[6] Except that the surface layer is thinner, classification and properties of this soil are the same as those of Geary silty clay loam, 6 to 12 percent slopes, eroded.

[7] Data are for the Wymore soils. See description of Sharpsburg and Wymore soils.

[8] Description, classification, and properties are for the Shelby soils. See description of Burchard and Shelby soils.

interpretations

Soil features affecting—Continued							
Foundations	Dikes and levees	Low dams		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
		Reservoir	Embankment				
Good to poor bearing.	(2)	Generally low seepage.	Good to fair stability.	(2)	High water-holding capacity; slow intake.	High erodibility.	Erodibility and droughtiness. Maintenance may be costly.
Good to poor bearing.	(2)	Generally low seepage.	Good to fair stability.	(2)	High water-holding capacity; slow intake.	High erodibility.	Erodibility and droughtiness. Maintenance may be costly.
(3)	(3)	(3)	(3)	Subject to frequent overflow.[3]	Frequent flooding; adequate drainage required.	(2)	(3).

TABLE 6.—*Engineering*

Soil series and map symbols	Engineering classification		Suitability for—						Soil features affecting—
	Unified	AASHO	Topsoil	Sand	Sand and gravel	Subgrade of paved road	Subgrade of gravel road	Road fill	Highway location
Barney soils (B2).	SM in surface soil and subsoil; SP to SM in substratum.	A–2 or A–4 in surface soil; A–2 in subsoil; A–3 or A–2 in substratum.	Fair to poor.	Good below 3 feet.	Good below 4 feet.	Good to poor.	Good to poor.	Good to poor.	Very high susceptibility to frost action; water table seasonally high. May require 4 to 7 feet of fill.
Burchard and Shelby (BSE, BSE2, BSE3).[4]	CL in surface soil; CL or CH in subsoil and substratum.	A–7–6 in surface soil, subsoil, and substratum.	Fair	(1)	(1)	Poor	Good	Poor	Moderate susceptibility to frost action.
Butler (Bt)	ML or CL in surface soil; CL or CH in subsoil and substratum.	A–6 or A–7–6 in surface soil, subsoil, and substratum.	Good	(1)	(1)	Poor	Good	Poor	High susseptibility to frost action; erodible slopes; subject to ponding.
Cass (Cs, 3Cs)	SM in surface soil and subsoil; SP to SM in substratum.	A–2 or A–4 in surface soil and subsoil; A–3 in substratum.	Fair	Fair in substratum.	(1)	Good to poor.	Good to poor.	Good to poor.	Very high susceptibility to frost action.
Colo (Ct, 2Ct)	CL in surface soil; CL or CH in subsoil; CL in substratum.	A–6 or A–7–6 in surface soil; A–7–6 in subsoil; A–6 or A–7–6 in substratum.	Fair to poor.	(1)	(1)	Poor	Good	Poor	High to moderate susceptibility to frost action; subject to occasional flooding; some ponding.
Fillmore (Fi, 2Fi).	CL in surface soil; ML or CL in subsoil; CL or CH in substratum.	A–6 or A–7–6 in surface soil; A–4 in subsoil; A–7–6 in substratum.	Fair	(1)	(1)	Fair to poor.	Good to fair.	Fair to poor.	High to moderate susceptibility to frost action; subject to ponding; moderately erodible slopes.
Geary (GeC2, GeC3).	CL or CH in surface soil; CL in subsoil and substratum.	A–6 or A–7–6 in surface soil, subsoil, and substratum.	Fair	(1)	(1)	Poor	Good	Poor	High susceptibility to frost action; highly erodible slopes.
Gullied land (GL).	(3)	(3)	Poor	(1)	(1)	(3)	(3)	(3)	(3)
Hobbs (Hz)	ML to CL in surface soil; CL in subsoil; ML to CL in substratum.	A–4 or A–6 in surface soil; A–6 in subsoil; A–4 or A–6 in substratum.	Good to fair.	(1)	(1)	Fair to poor.	Good	Fair to poor.	High susceptibility to frost action; subject to occasional overflow.
Judson (JfB, JtB).	SM to CL in surface soil; CL in subsoil and substratum.	A–4 or A–6 in surface soil; A–6 in subsoil and substratum.	Good to fair.	(1)	(1)	Fair to poor.	Good	Fair to poor.	High to moderate susceptibility to frost action; erodible slopes.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued							
Foundations	Dikes and levees	Low dams		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
		Reservoir	Embankment				
Good to fair bearing. May be subject to piping.	High susceptibility to piping. Mild slopes may be required.	Moderate seepage.	Fair stability. Close control required; toe drains may be required.	Generally good drainage. Outlets may not be available.	Moderate to low water-holding capacity; adequate drainage required.	(2)	Moderate erodibility.
Fair to poor bearing.	Slopes of dikes or levees erodible.	Low seepage.	Good to fair stability; impervious.	(2)	High water-holding capacity; slow intake.	Erodibility	Erodibility and droughtiness. Maintenance may be costly.
Fair to poor bearing.	(2)	(2)	Good to fair stability.	Subject to some ponding; poor internal drainage; outlets may not be available.	High water-holding capacity; slow intake; adequate drainage required.	Moderate erodibility.	Moderate erodibility.
Fair to good bearing, but generally good below a depth of 4 feet.	High susceptibility to piping. Mild slopes may be required.	Moderate seepage.	Fair stability. Mild slopes and toe drains may be required.	(2)	Moderate water-holding capacity.	(2)	High erodibility. Fertility low if subsoil is exposed.
Fair to poor bearing.	Slopes of dikes or levees may be erodible.	Low seepage.	Good to fair stability. Mild slopes may be required.	Occasional flooding.	High water-holding capacity; slow intake; adequate drainage required.	(2)	Moderate erodibility; may be droughty.
Fair to poor bearing.	Slopes of dikes or levees moderately erodible.	(2)	(2)	Slow internal drainage in subsoil; outlets may not be available.	High water-holding capacity; slow intake; adequate drainage required.	(2)	(2).
Fair bearing	Slopes of dikes or levees moderately erodible.	Low seepage.	Good to fair stability.	(2)	High water-holding capacity; slow intake.	High erodibility.	High susceptibility to water erosion. Fertility may be a problem; constructing and maintaining waterways may be costly.
(3)	(3)	(3)	(3)	(2)	(2)	(3)	(3).
Good to poor bearing; may be subject to piping.	Slopes of dikes or levees may be erodible; moderate susceptibility to piping.	Low to moderate seepage.	Good to poor stability; toe drains may be required.	Occasional flooding; moderately good drainage.	Moderate to high water-holding capacity; adequate drainage required.	Erodibility	Moderate erodibility.
Good to poor bearing.	Slopes of dikes or levees may be erodible; susceptible to piping.	Moderate to low seepage.	Good to fair stability; toe drains may be required.	(2)	Moderate to high water-holding capacity.	Erodibility	Moderate erodibility.

TABLE 6.—*Engineering*

Soil series and map symbols	Engineering classification		Suitability for—						Soil features affecting—
	Unified	AASHO	Topsoil	Sand	Sand and gravel	Subgrade of paved road	Subgrade of gravel road	Road fill	Highway location
Lamoure (Lb, 2Lb).	CL or CH in surface soil, subsoil, and substratum.	A-6 or A-7-6 in surface soil, subsoil, and substratum.	Good to fair.	(1)	(1)	Poor	Good	Poor	Very high to high susceptibility to frost action; erodible slopes; water table rises near the surface in some areas and may undermine pavement unless 4 to 7 feet of fill is used.
Leshara (Le, 2Le, 3Le).	ML to CL in surface soil, subsoil, and substratum.	A-3, A-4, A-6, or A-7-6 in surface soil, subsoil, and substratum.	Good to poor in alkali phase.	(1)	(1)	Good to poor.	Good to poor.	Good to poor.	Very high susceptibility to frost action; erodible slopes.
Luton (Lu, 2Lu).	CH in surface soil, subsoil, and substratum.	A-7-6 in surface soil, subsoil, and substratum.	Fair to poor.	(1)	(1)	Poor	Good	Poor	Low to moderate susceptibility to frost action; erodible slopes; water table rises to within 4 feet of the surface in some areas.
Made land (ML).	(3)	(3)	(1)	(1)	(1)	(3)	(3)	(3)	(3)
Malcolm (MnD2).	ML to CL in surface soil; CL in subsoil; SM in substratum.	A-4 in surface soil; A-6 in subsoil; A-2 or A-4 in substratum.	Good to poor.	Good for fine sand below 30 inches.	(1)	Good to poor.	Good to fair.	Good to poor.	High susceptibility to frost action; erodible slopes.
Mixed alluvial land (Sx).	(3)	(3)	Fair to poor.	Fair to good below 2 feet.	Fair to good below 2 feet.	(3)	(3)	(3)	Water table rises near surface in some places. May require 4 to 7 feet of fill.
Monona (MnC, MnC2, MnE, MnE2, MnF, MhC2, MhE2).	ML to CL in surface soil; SM or CL in subsoil; SP, SM, or CL in substratum.	A-6 or A-7-6 in surface soil; A-4, A-6, or A-7-6 in subsoil; A-2, A-3, A-6, or A-7-6 in substratum.	Good to fair.	Poor in most places, except for sand in sand substratum phases.	(1)	Good to poor.	Good to poor.	Good to poor.	High to very high susceptibility to frost action.
Morrill (MrC2, MrC3).	ML to CL in surface soil; CL to CH in subsoil; SM in substratum.	A-4 or A-6 in surface soil; A-6 or A-7-6 in subsoil; A-2 or A-4 in substratum.	Good to poor.	(1)	(1)	Good to poor.	Good to poor.	Good to poor.	High to very high susceptibility to frost action; erodible slopes in some places.
Muck (Mk)	ML to CL in surface soil, subsoil, and substratum.	A-4 to A-7-6 in surface soil, subsoil, and substratum.	Good	(1)	(1)	Fair to poor.	Good to fair.	Fair to poor.	Low to moderate susceptibility to frost action; erodible slopes in some places; may require 4 to 7 feet of fill.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued							
Foundations	Dikes and levees	Low dams		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
		Reservoir	Embankment				
Fair to poor bearing.	Slopes of dikes or levees may be erodible.	Low seepage.	Good to fair stability.	Poor internal drainage; outlets may not be available.	High water-holding capacity; low intake; adequate drainage required.	(2)	Moderate erodibility; droughtiness.
Good to poor bearing.	Slopes of dikes or levees may be erodible; susceptibility to piping.	Moderate to low seepage.	Good to poor stability. Close control may be required.	Occasional overflow.	Moderate water-holding capacity; adequate drainage required.	(2)	Erodibility. Growing plants in alkali areas is difficult.
Poor bearing.	Slopes of dikes and levees erodible.	Low seepage.	Fair stability; impervious. Compaction difficult.	Slow internal drainage; subject to occasional overflow.	High water-holding capacity; slow intake; adequate drainage required.	(2)	Erodibility and droughtiness. Maintaining waterways and keeping them in growing plants may be costly.
(3)	(3)	(3)	(3)	(2)	(2)	(2)	(2).
Good bearing if sand is confined; may be subject to piping.	(2)	Moderate seepage.	Fair stability; toe drainage may be required.	(2)	Moderate to low water-holding capacity.	Erodibility, especially below 30 inches.	Erodibility. If substratum is exposed, maintaining fertility is difficult.
(3)	(3)	(3)	(3)	(3)	(3)	(2)	(3).
Fair to poor bearing; subject to piping.	Mild slopes may be required; subject to piping.	Low to moderate seepage.	Fair to poor stability; may require toe drains.	(2)	Moderate to low water-holding capacity; erodible because of steep slopes.	High erodibility.	Moderate erodibility. Maintenance may be costly on steep slopes and where sand is exposed.
Good to poor bearing; may be subject to piping.	Mild slopes may be required.	Low to moderate seepage.	Fair to poor stability; toe drains may be required.	(2)	Moderate water-holding capacity; susceptibility to erosion.	High erodibility.	Moderate erodibility. Maintenance is costly on steep slopes and where sandy materials are exposed.
Fair to poor bearing; may be subject to piping.	Mild slopes may be required.	(2)	(2)	Moderate to slow internal drainage; outlets may not be available.	(2)	(2)	(2).

TABLE 6.—*Engineering*

Soil series and map symbols	Engineering classification		Suitability for—						Soil features affecting—
	Unified	AASHO	Topsoil	Sand	Sand and gravel	Subgrade of paved road	Subgrade of gravel road	Road fill	Highway location
Muir (Mt)	ML to CL in surface soil; CL or CH in subsoil and substratum.	A–7–6 in surface soil, subsoil, and substratum.	Good to fair.	(1)	(1)	Poor	Good	Poor	High susceptibility to frost action; erodible slopes in some places.
Ortello (OrC2, OrE2).	ML to CL in surface soil; SM in subsoil; SP to SM in substratum.	A–4 or A–6 in surface soil; A–4 in subsoil; A–3 or A–2 in substratum.	Good	Fair below 36 inches.	(1)	Good to poor.	Good to poor.	Good to poor.	High suseptibility to frost action; erodible slopes—in some places.
Pawnee (PwC2, PwD2).	CL or CH in surface soil; CH in subsoil and substratum.	A–6 or A–7–6 in surface soil; A–7–6 in subsoil and substratum.	Fair to poor.	(1)	(1)	Poor	Good	Poor	Moderate susceptibility to frost action; erodible slopes.
Platte (Pt)	ML to CL in surface soil; SM in subsoil; SP to SM in substratum.	A–4 or A–6 in surface soil; A–2 in subsoil; A–3 in substratum.	Good to fair.	Fair to good below 20 inches.	Fair to good below 20 inches.	Good to poor.	Good to poor.	Good to poor.	High to moderate susceptibility to frost action; erodible slopes; water table near surface in some places. Requires 4 to 7 feet of fill.
Rauville (Ra)	CL or CH in surface soil, subsoil, and substratum	A–6 or A–7–6 in surface soil and subsoil; A–7–6 in substratum.	Fair to poor.	(1)	(1)	Poor	Good	Poor	Moderate susceptibility to frost action; erodible slopes; water table near surface in some places. May require 4 to 7 feet of fill.
Riverwash (Rw).	(3)	(3)	Poor	Good	Good	(3)	(3)	(3)	Water may rise to surface.
Sarpy (Sa, 2Sa, Sg, 2Sg, 4Sg).	SP to SM in surface soil and subsoil; SP or SM in substratum.	A–3 or A–2 in suface soil; A–3 or A–2 in subsoil and substratum.	Fair to poor.	Good to fair below 18 inches.	Poor below 18 inches.	Good to poor.	Fair to poor.	Good to poor.	Low susceptibility to frost action; erodible slopes in some places.
Sharpsburg (ShA, ShB, ShC2, ShD2, ShD3, ShE2, ShE3).	ML to CL in surface soil; CH in subsoil; CL in substratum.	A–7–6 in surface soil, subsoil, and substratum.	Good to fair.	(1)	(1)	Poor	Good	Poor	Moderate susceptibility to frost action; erodible slopes.
Sharpsburg and Wymore (SWB, SWC2, SWD2, SWD3, SWE2, SWE3).[5]	CL or CH in surface soil; CH in subsoil; CL or CH in substratum.	A–6 or A–7–6 in surface soil; A–7–6 in subsoil; A–6 or A–7–6 in substratum.	Good to fair.	(1)	(1)	Poor	Good	Poor	Moderate susceptibility to frost action; erodible slopes.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued							
Foundations	Dikes and levees	Low dams		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
		Reservoir	Embankment				
Fair to poor bearing.	Mild slopes may be required.	Generally low seepage.	Fair to poor stability; compaction difficult.	(2)	High water-holding capacity.	Erodible slopes in some places.	Moderate erodibility.
Good to fair bearing if sand is confined; subject to piping.	Mild slopes may be required. Subject to piping.	Low to moderate seepage in most places; high seepage if sand is exposed.	Good stability if control is close; toe drains may be required.	(2)	Moderate water-holding capacity.	Erodible slopes in some places.	Erodibility; fertility low if sand is exposed.
Fair to poor bearing.	(2)	Low seepage.	Fair stability in the less sloping areas; compaction difficult.	(2)	High water-holding capacity; slow intake.	High erodibility. Construction may be costly.	Erodibility; fertility low if subsoil is exposed.
Good to fair bearing if sand is confined.	Mild slopes may be required. Subject to piping.	Moderate to high seepage.	Good stability if control is close; toe drains may be required.	Water table likely to be high.	Low water-holding capacity, adequate drainage required.	(2)	Erodibility; fertility low if subsoil is exposed.
Fair to poor bearing.	Slopes of dikes and levees erodible.	Low seepage.	Fair stability in less sloping areas; compaction difficult.	Poor surface drainage and internal drainage; outlets may not be available.	High water-holding capacity; slow intake; adequate drainage required.	(2)	Erodibility and droughtiness. Fertility low in some places
(3)	(3)	(3)	(3)	(3)	(3)	(2)	(3).
Good bearing if sand is confined.	Slopes of dikes and levees erodible; subject to piping.	Moderate to high seepage.	Fair stability in less sloping areas; pervious; compaction easy.	Permanently high water table in imperfectly drained phase.	Low water-holding capacity; adequate drainage required.	(2)	Erodibility; fertility low in some place.
Fair to poor bearing.	Slopes of dikes and levees erodible.	Low seepage.	Fair stability in less sloping areas; impervious. Compaction easy to difficult.	(2)	High water-holding capacity; slow intake.	Erodibility	Erodibility. Maintenance may be costly on steep slopes
Fair to poor bearing.	Slopes of dikes and levees erodible.	Low seepage.	Fair stability with flat slopes. Compaction fairly easy to difficult.	(2)	High water-holding capacity; slow intake.	Erodibility. Maintenance may be costly on steep slopes.	Erodibility. Maintenance may be costly on steep slopes; maintaining fertility may be difficult if subsoil is exposed.

TABLE 6.—*Engineering*

Soil series and map symbols	Engineering classification		Suitability for—						Soil features affecting—
	Unified	AASHO	Topsoil	Sand	Sand and gravel	Subgrade of paved road	Subgrade of gravel road	Road fill	Highway location
Shelby and Burchard (SBD, SBD2, SBD3).[5]	CL in surface soil; CL or CH in subsoil and substratum.	A–6 or A–7–6 in surface soil, subsoil, and substratum.	Good	(1)	(1)	Poor	Good	Poor	Moderate susceptibility to frost action; erodible slopes.
Steinauer (StE).	CL or CH in surface soil, subsoil, and substratum.	A–6 or A–7–6 in surface soil, subsoil, and substratum.	Good to fair.	(1)	(1)	Poor	Good	Poor	Moderate susceptibility to frost action; erodible slopes.
Volin (Vo)	ML to CL in surface soil, subsoil, and substratum.	A–4 or A–6 in surface soil, subsoil, and substratum.	Good	(1)	(1)	Fair to poor.	Good to fair.	Fair to poor.	Very high susceptibility to frost action; erodible slopes.
Wann (Wb, 2Wb, 3Wb).	SM in surface soil; SP or SM in subsoil; SP in substratum.	A–4 in surface soil; A–3 or A–2 in subsoil and substratum.	Good	Good below 48 inches.	Good below 48 inches.	Good to poor.	Good to poor.	Good to poor.	Moderate to low susceptibility to frost action.

[1] Sand or sand and gravel generally not available.
[2] Because of position, topography, and slope, or any of these, practice or structure is generally not needed or is not applicable.
[3] Because of the variable characteristics of this land type, engineering interpretation is not given.
[4] Estimated properties for the Burchard series.

is *high* if this percentage is 44 or more. For soils having between 50 and 63 percent of the surface soil in grains between 0.074 and 0.005 millimeter in size, susceptibility is *high* if less than 44 percent of the subsoil consists of grains finer than 0.005 millimeter and is *moderate* if this percentage is 44 or more. For soils having between 35 and 49 percent of the surface soil in grains between 0.074 and 0.005 millimeter in size, susceptibility is *moderate* if less than 50 percent of the subsoil consists of grains finer than 0.005 millimeter and is *low* if this percentage is 50 or more. Soils having less than 35 percent of the surface soil in grains between 0.074 and 0.005 millimeter, and more than 3 percent finer than 0.02 millimeter, are *low* in susceptibility to frost action, regardless of the percentage of grains smaller than 0.005 millimeter in the subsoil.

Soils that had not been mechanically analyzed were rated by comparing them with soils that had, or with soils of known properties.

For foundations the bearing quality of the soils and susceptibility to piping are rated for soil material below a depth of 3 feet.

The information for low dikes and levees applies to only the upper 18 inches of the profile. A detailed investigation of sites is needed if high dikes and levees are planned.

Sealing generally is not needed to hold the water in reservoirs behind small dams.

Compacted embankments are generally impervious and have fair to good stability, but toe drains may be required. The workability of soil materials ranges from *good* for clays of low or medium plasticity to *poor* for clays of high plasticity.

The kind of agricultural drainage that can be effectively used is determined by the water table, soil permeability, and availability of outlets. Soils on bottom land have poor natural drainage because the water table is seasonally high, because the soils are slowly permeable, or both. Also, a few of these soils are subject to flooding. Others are fairly flat and have slow runoff.

Under the column headed "Irrigation," water-holding capacity and water intake have been rated because these soil properties affect available water. The ratings for water-holding capacity are for the top 4 feet of soil. The water-holding capacity is *high* if more than 8 inches of water can be held in the top 4 feet. It is *moderate* if 5 to 8 inches can be held, *low* if 3 to 5 inches, and *very low* if less than 3 inches.

Water intake is rated for irrigation only if the rate is *rapid* or *slow*. A *slow* intake rate is less than one-half inch per hour, and a *rapid* one is 2 inches or more per hour. The intake rate for all soils is estimated for irrigating fields of growing plants by the border method or by sprinklers.

Because a large part of the areas cropped is erodible, terraces are commonly used in this county to conserve soil and water. Below terraces or grassland, diversions are used extensively to protect lower lying soils because many of them, although highly erodible, are very productive. Slopes of terraces generally also are erodible, but in most places the cost of maintenance is not extremely high. The steeper slopes, however, may be exceptions.

interpretations—Continued

Soil features affecting—Continued							
Foundations	Dikes and levees	Low dams		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
		Reservoir	Embankment				
Fair to poor bearing.	Slopes of dikes and levees erodible.	Low seepage.	Fair stability with flat slopes.	(2)	High water-holding capacity; slow intake.	Erodibility. Construction may be costly.	Erodibility. Construction and maintenance may be costly.
Fair to poor bearing.	Slopes of dikes and levees erodible.	Low seepage.	Fair stability with flat slopes.	(2)	High water-holding capacity; slow intake.	Erodibility. Construction may be costly.	Erodibility. Maintenance may be costly.
Good to poor bearing.	Slopes of dikes and levees erodible.	Moderate to low seepage.	Good to poor stability; needs good control.	(2)	Moderate water-holding capacity.	(2)	Erodibility.
Good bearing if sand is confined.	Slopes of dikes and levees erodible; subject to piping.	Moderate seepage.	Good to fair stability with good control; subject to piping.	Outlets may not be available.	Moderate water-holding capacity; adequate drainage required.	(2)	Erodibility. Fertility low in deep cuts.

[5] Estimated properties for the Wymore series.

[6] Estimated properties for the Shelby series.

Hummocky topography may limit the use of terraces and diversions.

For waterways, which are commonly used in the county, hazards that affect their construction and maintenance are named or rated. Considered in the ratings are the construction of waterways in highly plastic soils and the hazard of erosion after construction but before plants begin to grow. The semihumid climate helps to establish growing plants.

The suitability of the soils for winter grading is not rated in table 6, because suitability depends on the moisture content of the soil and on the temperature, both of which vary from year to year. If the soils receive a normal amount of water in fall, only a few of them are suitable for winter grading because most soils in the county have a high content of silt and clay. Also, some of the soils on bottom lands are subject to occasional flooding.

Formation and Classification of Soils

This section has five main parts. The first part names the factors of soil formation and relates these factors to the formation of soils in Saunders County. In the second part the soil series in the county are placed in higher categories. The third part discusses the great soil groups in the county. In the fourth part is a description of each soil series, including a detailed profile of a soil representative of the series. In the fifth part is a table that gives data on mechanical and chemical analyses.

Factors of Soil Formation

Soil is produced when soil-forming processes act on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent materials; (2) the plant and animal life on and in the soil; (3) the climate under which the soil material has accumulated and existed since accumulation; (4) the relief, or lay of the land; (5) the length of time the forces of soil development have acted on the soil material; and (6) activity of man.

Climate and vegetation are active factors of soil genesis. They act on the parent material and slowly change it into a soil with genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent materials also affect the kind of soil that is formed and, in extreme cases, determine it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile. Usually a long time is required for the development of distinct horizons.

Parent materials

The building of a land surface from geological materials can be compared to making a cake with many layers. Each layer of the cake represents the materials deposited in a geologic period, and each layer of frosting represents the period of weathering and soil formation. When the cake is cut, the various layers are exposed. If it were possible to cut Saunders County in like manner, the layers of geological materials would be exposed. A

limited study of the underlying materials can be made from deep excavations for buildings, road cuts, and well borings, and from exposures on steep banks along streams.

Of great importance, but not shown by the cake, is the wearing away, or erosion, of land surfaces that have been exposed to the action of wind and water. The hills and valleys in the present landscape were formed when the loose earth was moved by water and, to a lesser extent, by wind. In the deep valleys several of the geologic layers may be exposed.

The geologic materials exposed at the surface are parent materials of soils. If these parent materials are different in color, texture, or mineral composition the soils that develop from them will be different. The soils of the uplands in Saunders County developed on Peorian loess, Loveland loess, Kansan drift, and Aftonian silts and sands (*4*). Below the Aftonian silts and sands, but unimportant as parent material of present soils, is the Nebraskan drift, and below this are shale, sandstone, and limestone (*3*). Soils are also present on terraces and in recent alluvium in the valleys, some of which is so recent that soil development is just beginning. Following are separate discussions of the materials on uplands, terraces, and bottom lands.

UPLANDS

In Saunders County the uplands are a part of an eroded glacial drift plain that has been covered in most places by one or more layers of wind-deposited material called loess. This plain was formed when the Kansan ice sheet covered all of the county and left a mixture of sand, silt, clay, and gravel. Soils developed on the glacial mixture are in the Pawnee, Morrill, Shelby, Burchard, and Steinauer series. These soils are chiefly in the southwestern part of the county, but small areas of them are scattered throughout on steep slopes and rounded ridgetops where the loess either failed to accumulate or was later removed by erosion.

While the rest of the plain was being dissected, the Kansan drift was completely removed in some small areas, and Aftonian silts and sands were exposed. The loess that was deposited on the Aftonian silts and sands was either very thin or was eroded away, and the Malcolm soils formed on the underlying silts and sands.

The first loess to be deposited over the glacial drift was the Loveland. Locally, it may be seen at or near the surface on upland slopes and rounded ridgetops or in deep road cuts or gullies. Loveland loess is reddish brown and can be easily distinguished both from the brownish Peorian loess above it and from the glacial materials below it. The climate and vegetation favored soil development on the Loveland loess. The dark surface horizon and the thick subsoil indicate that grasses grew luxuriantly then, much as they do today, and that the surface remained undisturbed for a long time. This period of soil development ended when the climate changed, and there was a period of intense erosion. Then Peorian loess was deposited and this buried the Loveland loess and the remnants of the soil not removed by erosion. Remnants of the buried dark-colored soil can be observed in road cuts and excavations, as well as in fields where it crops out. Where the Loveland loess is exposed, the Geary soils have developed.

The Peorian loess ranges from yellow or yellowish brown to gray. It forms the surface of the present landscape throughout most of the county and is the most extensive parent material of soils on uplands and high terraces. Sharpsburg, Wymore, and Monona soils developed in Peorian loess.

Bedrock crops out at only a few places in Saunders County. Near Ashland the bedrock is limestone, which is quarried and used in construction. The Dakota sandstone crops out in sections 23 and 24, Township 13 North, Range 7 East, where it can be seen along the road and in the vicinity of Ceresco along the creek bank and highway. Greenhorn limestone, Graneros shale, and Dakota sandstone are exposed in a creek bank in the east half of section 5, Township 13 North, Range 5 East. No mappable areas of soils have developed from bedrock materials.

TERRACES

At one time terraces were stream flood plains, but now they are at several levels above the present streams. The highest and oldest are 30 to 90 feet above the bottom lands. They are covered with Peorian loess, as are the uplands. The soils on these terraces do not differ appreciably from the soils on the uplands that formed in similar materials on similar slopes. The most extensive terrace is the Todd Valley, an old valley that has been abandoned by the Platte River. This terrace is 6 to 8 miles wide and 30 miles long. It extends diagonally across the east-central part of the county southeastward from the vicinity of Cedar Bluffs, near the northern border, to Ashland, near the southeastern corner of the county. The terrace is underlain by deposits of sand and gravel that are almost identical to those on the bottom land of the present Platte River. Sharpsburg, Butler, and Fillmore soils developed on this terrace.

In the southwestern part of the county, there are low terraces or high bottoms that are flooded only when the streams are unusually high. The Muir soils developed on these low terraces or high bottoms.

Alluvial parent materials are present at the base of upland slopes throughout the county. The Judson soils developed in these areas.

BOTTOM LAND

The bottom land along the Platte River varies in width from less than a mile to more than 5 miles. The soils are in alluvial sand, silt, and clay that are underlain by sand and gravel. The bottom land is nearly level, except where there are low ridges, shallow depressions, and old abandoned sloughs or channels. In these alluvial materials on bottom land the Barney, Sarpy, Lamoure, Luton, Colo, Volin, Leshara, Cass, and Wann soils developed.

The soils along the upland drains are in silty to clayey alluvial sediments that are only a few feet above the present stream level and are subject to occasional flooding. As the streams subside, surplus water drains off readily, but local swales and depressions remain flooded until the water enters the soil or evaporates. The Colo, Lamoure, Luton, Leshara, and Hobbs soils developed on these alluvial materials.

Plant and animal life

After the parent material was deposited, bacteria, fungi, and other simple forms of life invaded it. After a time prairie grasses began to grow, and each year new grasses sent their extensive fibrous roots into the upper few feet of the soil. A dark-colored surface layer formed,

but the lower part of the soil retained the color and texture of the parent material. As soil development continued, the subsoil became more like that of the present soils.

Rodents and insects influenced soil development by mixing and loosening the soil. Larger animals grazed the grasses and compacted the surface. As these animals went to watering places, they made trails that later became gullies. The living matter eventually was returned to the soil, where it decayed and released materials that were used in the growth of other living organisms.

Climate

Climate is important in the formation of soils. The continental climate of Saunders County is characterized by wide seasonal variations. Temperatures are commonly below 0° F. in winter and above 100° in summer. The average precipitation is about 27 inches per year, of which approximately 20 inches, or 74 percent, falls during the growing season, from April through September. The soil is moist, and frost penetrates to a depth of 2 to 4 feet, but the soil is frozen for only a short period each year. Enough of the precipitation enters the soil and moves through it to remove the free lime from the surface layer and the subsoil. Because some colloids have moved from upper to lower layers in the zonal soils, claypans have formed in the swales and depressions of the stream terraces and uplands. As the direct or indirect result of climate, plant and animal life vary and affect the formation of soils.

Relief

The relief of Saunders County ranges from nearly level to hilly and blufflike. Slopes of 4 to 9 percent that are 200 to 800 feet long are dominant in the uplands. Shorter and steeper slopes border the drainageways. Nearly level areas are chiefly on the bottom lands and terraces. Some nearly level areas are on the broad divides but are larger than 100 acres in only a few places.

Relief, or lay of the land, affects runoff and drainage. In areas that have about the same plant cover and rainfall, runoff is rapid on steep slopes and is slower or lacking in level areas. In areas where a large amount of water runs off, little water enters the soil and the soil forms slowly. In these areas soil horizons are not distinct, and the solum is thin.

Time

The length of time that the soil has been forming affects the kind of soil that forms. If the parent materials have been in place for only a short time, the climate and vegetation have not had long to act and the soils are weakly developed. The Colo, Hobbs, Leshara, Wann, and Cass soils are examples of weakly developed soils. These are Alluvial soils that are forming from recently deposited sediments. The sediments were deposited during the last few centuries, some during the last few years.

The Monona, Sharpsburg, and Wymore soils have developed in loess that has been in place long enough for well-defined, genetically related horizons to form. This is also true of the Shelby and Pawnee soils, which formed in glacial till. The Burchard and Steinauer soils also formed in glacial till. They have been developing for a shorter period of time and are less deeply leached of lime carbonates. The longer the parent material is exposed to soil development, the more nearly the soil reaches equilibrium with its environment. Under grass a dark-colored surface layer develops in 100 to 200 years in this climate. Several centuries are required for the Sharpsburg, Shelby, Pawnee, or other mature soils of the uplands to develop.

Activity of man

The activity of man affects the rate that soils develop and the direction this development takes. Man's use of the soils has been destructive and constructive.

In many areas erosion has increased after man has cleared the land. All of the original surface layer has been removed, and deep gullies have cut into the subsoil. The gullies lengthen as runoff increases. Some gullies in the uplands have enlarged after man has straightened stream channels or has changed their gradient. Natural drainage has been altered because sediments from eroded uplands have collected in valleys and have filled water channels.

On the constructive side, man has improved large areas of bottom land and has made them suitable for cultivation by establishing drainage. Also, he has counteracted deficiencies in plant nutrients by adding fertilizer and other amendments to make the soil more productive. In many places man's activity has drastically changed the kinds of living organisms in the soils.

Most of these changes affect soil development. The effect of some changes may not be evident for centuries, for the soils form slowly, even if their environment is changed. But man can immediately change the soil by disturbing it, by adding chemicals, or by doing other things to make it suitable for his use.

Classification of Soils

Soils are placed in classes so that knowledge about them can be organized and applied more easily in predicting their behavior within farms, ranches, or counties. They are placed in broad classes so that large areas such as continents can be studied and compared. In the comprehensive system of soil classification followed in the United States (*2*), the soils are placed in six categories, one above the other. Beginning at the top, the six categories are order, suborder, great soil group, family, series, and type.

In the highest category the soils of the whole country are grouped into three orders, but thousands of soil types are recognized in the lowest category. The suborder and family categories have never been fully developed and thus have been little used. Attention has been given largely to the classification of soils as soil types and series within counties or comparable areas and to the subsequent grouping of the series into great soil groups and orders. Soil series, type, and phase are defined in the Glossary in the back of this report. Subdividing soil types into phases provides finer distinctions that are significant to soil use and management.

Classes in the highest category of the classification scheme are the zonal, intrazonal, and azonal orders (*10*). The zonal order is made up of soils with evident, genetically related horizons that reflect the predominant influence of climate and living organisms in their formation. In the intrazonal order are soils with evident, genetically

related horizons that reflect the dominant influence of a local factor of topography or parent materials over the effects of climate and living organisms. The azonal order consists of soils that lack distinct, genetically related horizons, commonly because of youth, resistant parent material, or steep topography.

The classification of all the soil series in Saunders County, according to orders and great soil groups, is shown in the following list:

ZONAL ORDER—
- Brunizem:
  - Adair
  - Burchard
  - Geary
  - Judson (intergrading toward Alluvial)
  - Malcolm
  - Monona
  - Morrill
  - Muir
  - Pawnee
  - Sharpsburg
  - Shelby
  - Wymore
- Chernozem:
  - Ortello (intergrading toward Regosols)

INTRAZONAL ORDER—
- Humic Gley:
  - Lamoure (intergrading toward Alluvial)
  - Luton (intergrading toward Alluvial)
  - Rauville

INTRAZONAL ORDER—Continued
- Planosol:
  - Butler (intergrading toward Brunizems)
  - Fillmore

AZONAL ORDER—
- Alluvial:
  - Barney
  - Cass (intergrading toward Brunizems)
  - Colo
  - Hobbs
  - Leshara
  - Platte
  - Sarpy
  - Volin
  - Wann
- Regosol:
  - Steinauer

Great Soil Groups in Saunders County

A great soil group consists of soils that have similar major characteristics. Each soil in a great soil group has the same kinds of principal horizons, though the degree of development may vary. Soils assigned to a great soil group may differ greatly in kind of parent material and in color, texture, age, position on the landscape, fertility, moisture-holding capacity, and erosion hazard.

The great soil groups into which the soils of Saunders County have been placed are the Brunizem, Chernozem, Humic Gley, Planosol, Alluvial, and Regosol.

The Brunizems are zonal soils that formed on well-drained sites under tall grasses of the prairie. They were formerly called Prairie soils (*2*). They occur in areas where the average annual rainfall ranges from about 27 to 45 inches and the average annual temperature ranges from about 43° to 55° F. The Brunizems of Saunders County are therefore dry Brunizems, approaching Chernozems, and are in a central position in respect to the range of average annual temperature. Brunizems generally have a very dark grayish-brown, medium acid A horizon and a dark yellowish-brown to dark grayish-brown, slightly acid B horizon. The C horizon is lighter colored than the B horizon and, in most places, is leached of lime carbonates. Boundaries between the A, B, and C horizons are not sharp. The content of organic matter decreases gradually with depth. Typically, the pH is lowest in the surface layer. It increases gradually with depth but then rises abruptly at the point in the C horizon where soluble products of soil weathering are not completely leached.

The Chernozems are zonal soils that have a thick, dark, granular A horizon that is rich in organic matter. The B horizon, commonly lighter colored than the A, has subangular blocky or prismatic structure. In most profiles calcium carbonate has accumulated in the B horizon. A typical Chernozem does not occur in Saunders County, but the Ortello soils are Chernozems that intergrade toward Regosols.

Humic Gley soils are in the intrazonal order. They formed in poorly drained areas. Unless these soils are artificially drained, water covers the surface part of the time and is near the surface throughout most of the growing season. The soils have a thick, black A horizon and a Bg or Cg horizon mottled with olive gray. They are generally noncalcareous in the surface layer and calcareous in the C horizon. The Rauville soils in Saunders County are typical of this great soil group. The Luton and Lamoure soils have some of the characteristics of the Humic Gley soils and some characteristics of Alluvial soils.

Planosols are intrazonal soils that have a moderately dark, acid A horizon and a claypan B2 horizon. The lower A horizon is leached. Planosols formed in broad, almost level or slightly depressed areas. The Fillmore soils in Saunders County are typical Planosols. The Butler soils are Planosols, but they resemble Humic Gley soils in some places and Brunizems in others.

The Alluvial soils are an azonal group of soils. They have little profile development. The parent materials have been in place for such a short time that soil-forming processes have not appreciably altered the alluvial sediments. Organic matter has been added to the surface horizon, but other evidence of soil formation is weak or absent. Alluvial soils range widely in texture, drainage, and reaction. They range from sand to clay, from well drained to poorly drained, and from acid to alkaline. Many Alluvial soils intergrade toward other great soil groups. In time, Alluvial soils on well-drained sites acquire characteristics of the Brunizems. Those that are alkali or saline have some of the characteristics of Solonetz soils, and those that are a little less wet than typical Humic Gley soils have some of the characteristics of the Humic Gley soils.

Regosols are azonal soils that formed on uplands from unconsolidated or only slightly consolidated parent materials that weathered and formed soils with weakly developed profiles. The typical profile has an A, an AC, and a C horizon. Regosols have varied characteristics. Soil development is weak; organic matter has accumulated in the surface horizon; some soluble materials have been removed from the surface layer; and the root zone is thick enough for grasses, trees, and shrubs to grow. The Steinauer soils of Saunders County are typical Regosols that developed in calcareous till.

Soil Series in Saunders County

This subsection describes the soil series of Saunders County and, for each series, a profile that has been observed in a named location. Other information about each series, and descriptions of the individual soils in the series, can be found in the section "Descriptions of the Soils."

Adair series.—Soils of the Adair series have a dark-colored A horizon and a prominent textural and structural B horizon. They developed in weathered, clayey glacial materials on moderately sloping and strongly sloping

uplands. They occur with the Morrill, Pawnee, and Geary soils. The Morrill and Pawnee soils developed in glacial material, but the Geary soils developed in Loveland loess. Adair soils are more clayey than Morrill soils. They are similar to Pawnee soils in degree of development and in texture of the various horizons.

The A horizon of Adair soils is Peorian or Loveland loess or a mixture of loess and glacial materials. It is medium acid, low in available phosphorus, and generally deficient in available nitrogen. Cultivated areas contain 1.5 to 2.0 percent organic carbon.

The B horizon is compact, reddish clay or silty clay. It is medium acid in the upper part and near neutral in the lower part, has very firm consistence when moist, swells to form a plastic mass when wet, and shrinks and cracks into very hard, angular blocks when dry. Many sand grains, pebbles, and small stones are present throughout. A stone line or other evidence of lithologic discontinuity marks the boundary between the reddish-brown parent materials from which Adair soils developed and the underlying glacial till.

Profile of an eroded area of Adair silty clay loam on a slope of 9 percent (220 feet north of the road and 450 feet west of SE. corner of the southwest quarter of sec. 7, T. 13 N., R. 5 E.):

A1p—0 to 7 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark gray (10YR 3/1) when moist; weak, medium and fine, subangular blocky structure breaking to weak, fine, granular structure; friable when moist; noncalcareous; abrupt, smooth boundary.

B21—7 to 15 inches, brown (7.5YR 5/4) light silty clay loam, dark brown (7.5YR 4/4) when moist; weak, medium and fine, blocky structure; firm when moist; noncalcareous; clear, smooth boundary.

B22—15 to 24 inches, brown (7.5YR 5/4) silty clay, dark reddish brown (5YR 3/3) when moist; weak, medium and fine, subangular blocky structure; very firm when moist; noncalcareous; gradual, smooth boundary.

B3—24 to 31 inches, reddish-brown (5YR 5/4) silty clay, reddish brown (5YR 4/4) when moist; weak, coarse, prismatic structure breaking to moderate, medium, blocky structure; very firm when moist; noncalcareous; clear, smooth boundary.

C1—31 to 42 inches, light reddish-brown (5YR 6/4) clay loam, yellowish red (5YR 5/6) when moist; moderate, coarse and very coarse, blocky structure; firm when moist; matrix noncalcareous; many, small soft lime concretions; in upper part of horizon aggregates are coated with organic material; gradual, smooth boundary.

C2—42 to 66 inches, brown (7.5YR 5/4) light clay loam, dark brown (7.5YR 4/4) when moist; weak, coarse and very coarse, blocky structure; firm when moist; matrix noncalcareous; few, small lime concretions.

Barney series.—The Barney series consist of dark, poorly drained, Alluvial soils that have a loamy sand subsoil. The subsoil generally grades to coarse sand or sand and gravel at a depth of 12 to 36 inches, but in Saunders County the depth to coarse sand or sand and gravel is 20 to 30 inches. The water table is at or near the surface in winter and spring and recedes into the sand and gravel during the growing season. Mottling is distinct, but gleying is faint or lacking. Small areas of marsh occur within areas of Barney soils. In a few small areas salts or alkali accumulate, but the concentration varies greatly during the year and from year to year.

Profile of Barney fine sandy loam (0.2 mile north and 100 feet west of the southeast corner of sec. 17, T. 17 N., R. 5 E.):

A11—0 to 5 inches, very dark gray (10YR 3/1) fine sandy loam, black (10YR 2/1) when moist; weak, fine, granular structure; very friable when moist; very strongly calcareous; clear, smooth boundary.

A12—5 to 10 inches, dark-gray (10YR 4/1) fine sandy loam, black (10YR 2/1) when moist; weak, fine, granular structure; very friable when moist; very strongly calcareous; clear, smooth boundary.

A13—10 to 14 inches, gray (10YR 5/1) fine sandy loam, very dark gray (10YR 3/1) when moist; few, fine, distinct, yellowish-brown mottles; weak, coarse, subangular blocky structure; very friable when moist; very strongly calcareous; abrupt, smooth boundary.

AC—14 to 26 inches, light-gray (10YR 7/1) loamy sand, gray (10YR 5/1) when moist; few, fine, distinct, yellowish-brown mottles; massive (structureless); very friable when moist; weakly calcareous; gradual, wavy boundary.

C1—26 to 36 inches, fine sand and coarse sand.

Burchard series.—Soils of the Burchard series are dark, well-drained, weakly developed Brunizems that developed in calcareous till of Kansan age. These soils have less distinct horizons than the Pawnee and Shelby soils. They have a weakly developed B horizon. Lime has been leached to a greater depth in Burchard soils than in the associated Steinauer soils, which are Regosols, but not to as great a depth as in Pawnee and Shelby soils. The principal variations in the Burchard profile are the depth to calcareous till, which ranges from 12 to 30 inches, and the degree of development in the B horizon.

Typical profile on a moderately eroded slope of 12 percent in a cultivated field (1,100 feet south and 30 feet west of the northeast corner of sec. 30, T. 13 N., R. 6 E.). Sample number S-58-Neb-78-1-(1-8):

A1p—0 to 6 inches, very dark grayish-brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; friable when moist; no effervescence; abrupt, smooth boundary.

A12—6 to 9 inches, very dark grayish-brown (10YR 3/2) clay loam, black (10YR 2/1) when moist; weak, coarse, subangular blocky structure breaking to moderate, medium, granular structure; friable when moist; no effervescence; abrupt, smooth boundary.

B21—9 to 13 inches, dark grayish-brown (10YR 4/2) clay loam, dark brown (10YR 3/3) when moist; weak, coarse, prismatic structure breaking to moderate, fine and medium, subangular blocky structure; slightly hard when dry, friable when moist; no effervescence; thin, discontinuous clay skins on aggregates; clear, smooth boundary.

B22—13 to 20 inches, dark grayish-brown (10YR 4/2) heavy clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to strong, fine and medium, subangular blocky structure; hard when dry, firm when moist; no effervescence; thin, continuous clay skins on aggregates; few small iron stains; abrupt, smooth boundary.

B3ca—20 to 24 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure breaking to moderate, medium, subangular blocky structure; hard when dry, firm when moist; violent effervescence; few pockets of disseminated lime; thin, discontinuous clay skins on aggregates; clear, smooth boundary.

C1—24 to 36 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) when moist (slightly weathered till); many, fine, distinct, yellowish-brown and dark-brown mottles; strong, medium and coarse, blocky structure; very hard when dry, very firm when moist; violent effervescence; small pockets and channels of soft, white lime; gradual, smooth boundary.

C2—36 to 48 inches, 50 percent light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) when moist, and 50 percent yellowish-brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) when

moist (slightly weathered till); many, fine, distinct, yellowish-brown and dark-brown mottles; strong, medium and coarse, blocky structure; very hard when dry, very firm when moist; violent effervescence; many pockets and channels of soft, white lime; horizon streaked with reddish-brown iron stains; gradual, smooth boundary.

C3—48 to 60 inches, approximately 50 percent light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) when moist, and 50 percent yellowish-brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) when moist (slightly weathered till); many, fine, distinct, yellowish-brown and dark-brown mottles; strong, medium and coarse, blocky structure; very hard when dry, very firm when moist; violent effervescence; many pockets and channels of soft, white lime; horizon streaked with reddish-brown iron stains.

Medium and coarse gravel is scattered throughout the profile.

Butler series.—Soils of the Butler series are dark, somewhat poorly drained Planosols that, in Saunders County, intergrade toward Brunizems. Butler soils developed in loess of Peorian age. Most profiles lack an A2 horizon, which is evident in Planosols. Like Planosols, however, the boundary between the A and B horizons is abrupt, and the B horizon is 45 to 60 percent clay. Butler soils are better drained than the Fillmore soils, but surface drainage and internal drainage are slow. They are adjacent to Fillmore soils and, in some places, surround them. They occur with Sharpsburg soils, which are in well-drained areas.

The A horizon is friable, granular silty clay loam 10 to 18 inches thick. The B horizon is compact, blocky silty clay or clay. In the upper part of the B horizon the larger peds are coated with thick, continuous, dark-colored colloidal material. The C horizon is gray or pale-brown silty clay loam. In most places, it is leached of lime in the upper 6 to 12 inches and concretions of lime carbonate or disseminated lime occur at a depth greater than 54 to 72 inches.

Typical profile in a nearly level cultivated field (250 feet south and 100 feet west of the north quarter corner of sec. 15, T. 15 N., R. 8 E.):

A1p—0 to 6 inches, gray (10YR 5/1) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

A12—6 to 13 inches, dark-gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) when moist; moderate, fine and medium, granular structure; slightly hard when dry, friable when moist; noncalcareous; peds in the lower part of this horizon sprinkled with grains of gray silt; abrupt, smooth boundary.

B2—13 to 37 inches, dark-gray (10YR 4/1) silty clay or clay, black (10YR 2/1) when moist; weak, coarse, subangular blocky structure breaking to strong, fine and medium, angular blocky structure; thick, continuous colloidal coatings on peds; very hard when dry, very firm when moist; noncalcareous; clear, smooth boundary.

B3—37 to 50 inches, dark-gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) when moist; weak, coarse, subangular blocky structure breaking to moderate, fine and medium, angular blocky structure; very hard when dry, very firm when moist; noncalcareous; clear, smooth boundary.

C1—50 to 57 inches, gray (10YR 5/1) silty clay loam, dark gray (10YR 4/1) when moist; weak granular structure; hard when dry, firm when moist; noncalcareous; clear, smooth boundary.

C2—57 to 62 inches, gray (10YR 5/1) silty clay loam, dark gray (10YR 4/1) when moist; few, fine, faint, gray mottles; weak, fine, granular structure; hard when dry, firm when moist; contains lime concretions.

Cass series.—The Cass series consists of moderately deep or deep soils that have a fine sandy loam subsoil. They developed in loamy alluvium that is underlain by stratified, coarse alluvium. These soils are on high, well-drained bottom lands along the Platte River. Slopes are nearly level but are broken in a few places by a shallow channel or by low hummocky places.

Cass soils are Alluvial soils that intergrade toward Brunizems. Their B horizon does not differ from adjacent horizons in texture, but in many places it does differ in color. Lime carbonates have been leached to a depth of 3 to 6 feet.

The A horizon is dark, very friable, medium acid fine sandy loam with granular structure. The subsoil is grayish-brown or brown, very friable fine sandy loam that is medium acid or slightly acid. Its structure is weak and subangular blocky. A few, fine, faint, yellowish-brown mottles are in the C horizon in some places. The water table is 6 to 10 feet below the surface, except for short wet periods when it rises to within 3 to 6 feet of the surface.

Profile of Cass fine sandy loam, moderately deep (0.1 mile south and 150 feet west of the northeast corner of sec. 21, T. 17 N., R. 5 E.):

A1p—0 to 5 inches, gray (10YR 5/1) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; very friable when moist; noncalcareous; abrupt, smooth boundary.

A12—5 to 9 inches, gray (10YR 5/1) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure; very friable when moist; noncalcareous; abrupt, smooth boundary.

AC—9 to 20 inches, light-gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) when moist; weak, coarse, subangular blocky structure; very friable when moist; noncalcareous; gradual, smooth boundary.

C1—20 to 24 inches, light-gray (10YR 7/2) loamy sand, light brownish gray (10YR 6/2) when moist; very friable when moist; noncalcareous; abrupt, smooth boundary.

D—24 inches +, coarse sand and fine gravel.

Profile of Cass fine sandy loam, deep (500 feet north and 100 feet west of the southeast corner of sec. 25, T. 14 N., R. 9 E.). Sample number S–53–Neb–78–4–(1–7):

Alp—0 to 6 inches, dark-gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) when moist; moderate, fine and very fine, granular structure; slightly hard when dry, very friable when moist; noncalcareous; partly decayed crop residues mixed throughout; abrupt, smooth boundary.

A12—6 to 15 inches, dark-gray (10YR 4/1) loam, black (10YR 2.5/1) when moist; weak, medium and coarse, subangular blocky structure breaking to moderate, fine, crumb and to moderate, very fine, granular structure; slightly hard when dry, very friable when moist; many fine and very fine pores and root openings in larger aggregates; noncalcareous; gradual, smooth boundary.

AC—15 to 22 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) when moist; very weak, coarse and very coarse, subangular blocky structure breaking to moderate, fine and very fine, granular structure; slightly hard when dry, very friable when moist; many fine and medium pores and root openings in larger aggregates; noncalcareous; gradual, smooth boundary.

Cl—22 to 29 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3.5/2) when moist; weak, fine and very fine, granular structure; slightly hard when dry, very friable when moist; many medium and large pores; noncalcareous; some mixing of lighter colored materials from below by worms; gradual, smooth boundary.

C2—29 to 36 inches, light brownish-gray (10YR 6/2.5) loamy fine sand, grayish brown (10YR 5/2) when moist; appears massive in place when moist but breaks into very weak, medium and fine, subangular blocks when dry; slightly hard when dry, very friable when moist; noncalcareous; gradual, smooth boundary.

C3—36 to 49 inches, pale-brown (10YR 6/3) loamy very fine sand, grayish brown (10YR 5.5/2) when moist; massive breaking into rounded lumps that, when dry, crush easily to single grains; slightly hard when dry, very friable when moist; noncalcareous; abrupt boundary.

D—49 to 60 inches, medium to coarse sand (not sampled).

Colo series.—The Colo series consists of dark, moderately well drained Alluvial soils that have a silty clay loam subsoil. They developed on nearly level bottom lands that are flooded occasionally.

The A horizon is dark, friable, slightly acid silty clay loam with granular structure. It is underlain by very dark brown silty clay loam that grades to lighter colored silty clay loam or to gray or dark-gray silty clay. The soils that have a silty clay lower subsoil or substratum are mottled gray and brown in the lower horizons.

Typical profile (125 feet east and 75 feet north of the southwest corner of the southeast quarter of sec. 11, T. 14 N., R. 7 E.):

Alp—0 to 8 inches, dark-gray (10YR 4/1) silty clay loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; friable when moist; noncalcareous; abrupt, smooth boundary.

A12—8 to 14 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) when moist; strong granular structure; friable when moist; noncalcareous; gradual, smooth boundary.

A13—14 to 26 inches, very dark gray (10YR 3/1) silty clay, black (10YR 2/1) when moist; medium granular structure; firm when moist; noncalcareous; gradual, smooth boundary.

AC—26 to 31 inches, dark-gray (10YR 4/1) heavy silty clay loam, black (10YR 2/1) when moist; moderately fine, subangular blocky structure; firm when moist; noncalcareous; clear, smooth boundary.

C1—31 to 38 inches, silty clay loam, dark grayish brown (2.5Y 4/2) moist; few, fine, distinct, yellowish-brown and dark-brown mottles; fine and medium, subangular blocky structure; firm when moist; noncalcareous; abrupt, smooth boundary.

C2—38 to 48 inches +, silty clay loam, dark grayish brown (2.5Y 4/2) when moist; many, medium, distinct, yellowish-brown and gray mottles; massive; firm when moist; few medium and coarse sand grains; noncalcareous.

Fillmore series.—Soils in the Fillmore series are Planosols that developed in basins and in shallow depressions of loess-mantled high terraces and uplands. They have poor surface drainage and slow internal drainage. Surface drainage is poorer than that from Butler soils. Fillmore soils have a more clayey subsoil than the associated Sharpsburg soils. They have a prominent A2 horizon, but Butler soils have an indistinct or thin A2 horizon.

The A1 horizon is gray to black, friable silty clay loam or silt loam with granular structure. The A2 horizon is gray, very friable silt loam with platy structure. Reaction is medium acid in the A1 and A2 horizons. The upper part of the B horizon is black or very dark gray, compact silty clay with subangular blocky structure, and the lower part is gray silty clay with angular blocky structure. The substratum is light-gray to grayish-brown silty clay loam mottled with yellowish-brown and dark-brown iron stains. Concretions of lime carbonate occur below a depth of 5 or 6 feet.

Profile of Fillmore silty clay loam (0.2 mile east and 150 feet south of the north quarter corner of sec. 12 T. 15 N., R. 7 E.):

Alp—0 to 8 inches, gray (10YR 5/1) silty clay loam, black (10YR 2/1) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A21—8 to 10 inches, gray (10YR 6/1) silt loam, dark gray (10YR 4/1) when moist; weak, thin and medium, platy structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A22—10 to 14 inches, light-gray (10YR 7/1) silt loam, gray (10YR 5/1) when moist; weak, medium, platy structure breaking to weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

B2—14 to 35 inches, very dark gray (10YR 3/1) silty clay, black (10YR 2/1) when moist; moderate, coarse, prismatic structure breaking to moderate and strong, medium and fine, blocky structure; very hard when dry, very firm when moist; noncalcareous; clear, smooth boundary.

B3—35 to 45 inches, gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) when moist; weak, coarse, subangular blocky structure breaking to weak, fine, blocky structure; very hard when dry, very firm when moist; noncalcareous; gradual, smooth boundary.

C1—45 to 56 inches, grayish-brown (10YR 5/2) silty clay, dark gray (10YR 4/1) when moist; weak, fine, blocky structure; very hard when dry, very firm when moist; noncalcareous; clear, smooth boundary.

C2—56 to 60 inches, light-gray (10YR 7/2) silty clay loam, grayish brown (10YR 5/2) when moist; weak, fine, blocky structure; slightly hard when dry, firm when moist; common, fine, distinct, yellowish-brown and reddish-brown mottles; noncalcareous.

Geary series.—Soils in the Geary series are well-drained Brunizems that developed on upland slopes in reddish-brown Loveland loess. These soils occur in small areas where there is no overlying Peorian loess, or only a thin layer. The Loveland loess is only 2 to 4 feet thick and is underlain by glacial material. The main difference between the Geary soils and the Morrill soils is that the solum of the Geary soils developed in loess, but the solum of the Morrill soils developed in sandy glacial materials. The Geary soils have good to excessive surface drainage and moderately slow internal drainage.

Profile of Geary silty clay loam, eroded, on a slope of 7 percent (0.18 mile west and 75 feet north of the southeast corner of sec. 26, T. 13 N., R. 5 E.):

Alp—0 to 8 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

B2—8 to 14 inches, brown (7.5YR 5/4) silty clay loam, dark reddish brown (5YR 3/4) when moist; weak, medium, subangular blocky structure breaking to moderate, fine and medium, granular structure; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

B3—14 to 30 inches, brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) when moist; weak, medium, subangular blocky structure breaking to weak, fine and medium, granular structure; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

C—30 to 38 inches, strong-brown (7.5YR 5/6) clay loam, brown (7.5YR 5/4) when moist; weak, fine and medium, granular structure; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

D—38 to 54 inches, reddish-yellow (7.5YR 6/6) heavy clay loam, strong brown (7.5YR 5/6) when moist; massive; hard when dry, firm when moist; noncalcareous.

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Hobbs series.—In the Hobbs series are moderately well drained Alluvial soils that developed in silt loam and silty clay loam alluvium on occasionally flooded, nearly level bottom lands. These soils are less clayey than the Colo soils, contain more silt and less sand than Cass soils, and have better drainage than Leshara soils.

The profile is noncalcareous throughout; it ranges from slightly acid to neutral. Sediments have slowly accumulated, and the profile is dark to a considerable depth, but there is no evidence of soil development other than the accumulation of organic matter and weak structure. In many places lenses occur that are more clayey or more sandy than the loam or silt loam. These soils are usually well drained or moderately well drained, but in years when precipitation is above average they are almost imperfectly drained.

Profile of Hobbs silt loam in a cultivated field (0.25 mile west and 0.2 mile north of the southeast corner of sec. 22, T. 13 N., R. 5 E.):

A1p—0 to 8 inches, light brownish-gray (10YR 6/2) heavy silt loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; soft when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

A12—8 to 13 inches, grayish-brown (10YR 5/2) heavy silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine and medium, granular structure; soft when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

A13—13 to 20 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure breaking to weak, fine, granular structure; soft when dry, friable when moist; noncalcareous; clear, smooth boundary.

A14—20 to 26 inches, gray (10YR 5/1) silty clay loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

A1b—26 to 30 inches, dark-gray (10YR 4/1) heavy silt loam, black (10YR 2/1) when moist; weak, thin and medium, platy structure breaking to weak, fine, granular structure; soft when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

C1—30 to 40 inches, grayish-brown (10YR 5/2) heavy silt loam, dark grayish brown (10YR 4/2) when moist; few, fine, faint, yellowish-brown mottles; weak, fine, granular structure; soft when dry, friable when moist; noncalcareous; gradual, smooth boundary.

C2—40 to 60 inches, gray (10YR 5/1) silty clay loam, very dark grayish brown (10YR 3/2) when moist; few, fine, faint, yellowish-brown mottles; weak, fine, granular structure; soft when dry, friable when moist.

Judson series.—In the Judson series are well-drained Brunizems that intergrade toward Alluvial soils. They developed in dark-colored material that washed from adjacent uplands and accumulated on foot slopes or as alluvial fans on nearly level terraces and bottom lands.

The A horizon is more than 20 inches thick. A weak color or structural B horizon occurs in some places, or the A horizon grades gradually to the loesslike substratum. Material from adjacent slopes slowly accumulated and built up the thick, dark A horizon. Weak soil development below the surface layer distinguishes the Judson soils from the associated Sharpsburg, Wymore, and Shelby soils and from other less extensive soils on uplands. Judson soils are distinguished from adjacent Colo soils of the bottom lands by their brown, unmottled subsoil and their position on well-drained foot slopes and fans.

Profile of Judson silty clay loam (0.15 mile east of the southwest corner of sec. 19, T. 15 N., R. 5 E.):

A1p—0 to 7 inches, dark-gray (10YR 4/1) silty clay loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A12—7 to 17 inches, dark-gray (10YR 4/1) silty clay loam, very dark brown (10YR 2/2) when moist; weak, coarse, subangular blocky structure breaking to moderate, fine, granular structure; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.

A13—17 to 31 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to moderate, fine and medium, granular structure; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

AC—31 to 42 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure breaking to moderate, fine, subangular blocky structure; slightly hard when dry, friable when moist; noncalcareous; gradual, smooth boundary.

C—42 to 56 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous.

Lamoure series.—The Lamoure series consists of imperfectly drained Humic Gley soils that developed in alluvium and have some characteristics of Alluvial soils on nearly level bottom lands. They are more clayey than Leshara soils and less clayey than Luton soils. Lamoure soils are not so well drained as Colo soils.

The A horizon is dark-colored, slightly calcareous silty clay loam, silt loam, or silty clay. The subsoil is very dark gray or black silty clay loam. The horizons in the subsoil range from heavy silt loam to light silty clay. The lower subsoil and the substratum are mottled and, in many places, are gleyed.

Profile of Lamoure silty clay loam (125 feet south and 125 feet west of the northeast corner of sec. 14, T. 14 N., R. 9 E.):

A11—0 to 8 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; moderate, medium and fine, granular structure; firm when moist; slightly calcareous; clear, smooth boundary.

A12—8 to 23 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; moderate, coarse, granular structure; firm when moist; calcareous; gradual, smooth boundary.

AC—23 to 36 inches, dark-gray (10YR 4/1) heavy silty clay loam, black (10YR 2/1) when moist; few, distinct, gray and yellowish-brown mottles; moderate, medium, blocky structure breaking to moderate, medium and fine, granular structure; firm when moist; slightly calcareous; gradual, smooth boundary.

C1—36 to 42 inches, gray (2.5YR 5/1) heavy silty clay loam, very dark gray (2.5Y 3/1) when moist; weak, fine and medium, blocky structure; firm when moist; calcareous.

Leshara series.—The Leshara series consists of imperfectly drained Alluvial soils that developed in loamy alluvium on nearly level bottom lands. They are less clayey than Lamoure soils, contain more silt and less sand than Wann soils, and are not so well drained as Volin soils.

The parent material is silty or slightly sandy, contains thin lenses of sand and clay, and is underlain by coarse sand or sand and gravel. The subsoil is mottled. In many places weak gleying occurs in the lower subsoil and in silty or clayey horizons in the substratum.

Profile of Leshara silt loam (500 feet south and 50 feet west of the northeast corner of the northwest quarter of

sec. 25, T. 13 N., R. 9 E.). Sample No. S–53–Neb–78–3–(1–8):

Alp—0 to 6 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; strong, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

A12—6 to 10 inches, gray (10YR 5/1.5) silt loam, very dark grayish brown (10YR 3/2) when moist with some lighter colored worm casts; strong, medium and fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

AC—10 to 13 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2), when moist; some darker colored worm casts; moderate, medium and fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

C1—13 to 19 inches, light brownish-gray (10YR 6.5/2) silt loam, grayish brown (10YR 5/2) when moist; many, prominent, fine, brown mottles and stains; moderate, medium and fine, granular structure; soft when dry, friable when moist; many fine and medium pores and root openings; calcareous; clear, smooth boundary.

C2—19 to 26 inches, light-gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) when moist; common, distinct, fine, brown mottles; massive or very weak, coarse, subangular blocky structure; soft when dry, very friable when moist; noncalcareous, or calcareous only in spots; clear, smooth boundary.

C3—26 to 32 inches, light brownish-gray (2.5Y 6/2) silt loam, dark gray (2.5Y 4/1) when moist; stratified with thin lenses of lighter colored silt loam or very fine sandy loam; weak, fine, granular structure; soft when dry, friable when moist; violent effervescence; many, white lime spots and small, soft concretions; clear, smooth boundary.

C4—32 to 46 inches, very light gray (2.5Y 7.5/2) silt loam, light brownish gray (2.5Y 6/2) when moist; common, distinct, fine and coarse, brown mottles; massive; soft when dry, very friable when moist; weak effervescence; abrupt boundary.

Cg—46 to 52 inches, stratified dark-gray and light-gray (10YR 4/1 and 7/1) silty clay or silt clay loam, black or light brownish gray (10YR 2/1.5 or 6/2) when moist; common, fine, faint, brown mottles; weak, medium, subangular blocky structure breaking to medium and fine, granular structure; hard when dry, firm when moist; strong effervescence; pores and openings filled with lime.

Luton series.—This series consists of Humic Gley soils that developed in clayey alluvium on bottom lands of the Platte River and Wahoo Creek. These soils have some characteristics of Alluvial soils. Luton soils are more clayey than Lamoure soils and more clayey and better drained than Rauville soils.

The A horizon is dark-colored, medium acid silty clay. Overwash of silty clay loam covers a few areas. The subsoil is very dark gray or black silty clay or clay that is distinctly mottled and stained with gray and yellowish brown. Modal Luton soils are calcareous in the subsoil, but more than half of their acreage in Saunders County is free of lime to a depth of 4 feet or more. In many profiles the depth to free lime ranges from 6 to more than 60 inches.

The substratum is alluvium that is clayey or silty in most places and sandy in a few. In some areas the water table is at a depth of 3 to 5 feet, and in others it is at 6 feet or more.

Profile of Luton silty clay (275 feet east and 275 feet south of the northwest corner of the southwest quarter of sec. 35, T. 13 N., R. 9 E.):

Alp—0 to 6 inches, dark-gray (2.5Y 4/0) silty clay, very dark gray (2.5Y 3/0) when moist; moderate, fine and medium, granular structure; very hard when dry, very firm when moist; abrupt, smooth boundary.

A12—6 to 11 inches, dark-gray (2.5Y 4/0) clay, very dark gray (2.5Y 3/0) when moist; moderate, fine and medium, granular structure; extremely hard when dry, extremely firm when moist; noncalcareous; abrupt, smooth boundary.

A13—11 to 26 inches, very dark gray (2.5YR 3/0) clay, black (2.5Y 2/0) when moist; few, medium, distinct mottles of gray, yellowish brown, and reddish brown; strong, fine and medium, blocky structure; extremely hard when dry, extremely firm when moist; noncalcareous; clear, smooth boundary.

A14—26 to 32 inches, dark-gray (2.5Y 4/0) clay, very dark gray (2.5Y 3/0) when moist; few, medium, distinct mottles of gray, yellowish brown, and reddish brown; strong, fine and medium, granular structure; extremely hard when dry, extremely firm when moist; noncalcareous; clear, smooth boundary.

AC—32 to 48 inches, gray (2.5Y 5/0) silty clay, very dark gray (2.5Y 3/0) when moist; few, medium, distinct mottles of gray, yellowish brown, and reddish brown; moderate, fine and medium, granular structure; very hard when dry, very firm when moist; noncalcareous; clear, smooth boundary.

C—48 to 60 inches, grayish-brown (2.5Y 5/2) silty clay loam, olive gray (5Y 4/2) when moist; few, medium, distinct mottles of gray, yellowish brown, and reddish brown; massive; firm when moist; calcareous.

Malcolm series.—Soils in this series are well-drained Brunizems that developed in silts of Aftonian age. They occur with Morrill and Shelby soils that developed in glacial materials and with the Judson soils that are on foot slopes.

Profile of Malcolm silt loam on a slope of 12 percent (0.15 mile east and 125 feet north of the southwest corner of sec. 35, T. 13 N., R. 6 E.):

A1—0 to 8 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, crumb structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

B2—8 to 15 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, subangular blocky structure breaking to moderate, fine and medium, granular structure; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

C1—15 to 22 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; weak, fine and medium, blocky structure breaking to weak, medium, granular structure; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

C2—22 to 30 inches, very pale brown (10YR 8/3) silty clay loam, pale brown (10YR 6/3) when moist; massive; soft when dry, very friable when moist; noncalcareous; gradual, smooth boundary.

C3—30 to 60 inches, white (10YR 8/2) loamy very fine sand, light gray (10YR 7/2) when moist; massive; loose when dry, very friable when moist; noncalcareous.

Monona series.—Soils in the Monona series are well-drained Brunizems that have a dark-colored A horizon and a weak structural B horizon. The subsoil contains little or no more clay than the parent material. In some places lime has been leached to a considerable depth, and in other places it is within a few inches of the surface. Monona soils are not so well developed as are the associated Sharpsburg soils. The Monona soils bordering the Platte River are typical of the series.

Profile of Monona silt loam (0.3 mile east and 0.2 mile south of the northwest corner of sec. 12, T. 16 N., R. 8 E.):

Alp—0 to 7 inches, dark-gray (10YR 4/1) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, very

friable when moist; noncalcareous; abrupt, smooth boundary.

A12—7 to 10 inches, dark grayish-brown (10YR 4/2) silt loam, dark brown (10YR 4/3) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

B—10 to 26 inches, brown (10YR 5/3) silt loam, dark brown (10YR 4/3) when moist; weak, medium, subangular blocky structure; slightly hard when dry, friable when moist; noncalcareous; gradual, smooth boundary.

C1—26 to 52 inches +, pale-brown (10YR 6/3) silt loam, yellowish brown (10YR 5/4) when moist; massive; slightly hard when dry, very friable when moist.

Profile of Monona silt loam, sand substratum, on a slope of 12 percent (0.1 mile north of the southeast corner of sec. 29, T. 16 N., R. 8 E.):

A1p—0 to 9 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

AC—9 to 19 inches, light yellowish-brown (10YR 6/4) silt loam, yellowish brown (10YR 5/4) when moist; weak, coarse, subangular blocky structure; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

C1—19 to 25 inches, very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) when moist; weak, coarse, subangular blocky structure; soft when dry, very friable when moist; strongly calcareous; gradual, smooth boundary.

C2—25 to 32 inches, very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) when moist; weak, coarse, subangular blocky structure; loose when dry, very friable when moist; strongly calcareous; abrupt, wavy boundary.

C3—32 to 62 inches, light-gray (10YR 7/2) fine and medium sand, pale brown (10YR 6/3) when moist; massive; loose; strongly calcareous.

Morrill series.—Soils in the Morrill series are well-drained Brunizems that have a dark-colored A horizon and a textural and structural B horizon. Lime has been leached to a depth of 5 feet. Morrill soils are inextensive in Saunders County.

The reddish-brown color of the subsoil material is thought to have originated when the Loveland loess weathered. Reworking of Loveland loess and glacial materials resulted in the reddish parent materials from which the Morrill soils developed. In uneroded areas, the surface horizon is principally loess of Peorian age. The substratum is glacial materials of Kansan age.

Morrill soils occur with Geary, Adair, Pawnee, and Shelby soils. They are less clayey than Adair, Pawnee, and Shelby soils. Morrill soils contain coarse sand and gravel, but Geary soils do not.

Profile of Morrill loam, eroded, on a slope of 7 percent (160 feet east and 40 feet north of the southwest corner of the southeast quarter of sec. 15, T. 13 N., R. 6 E.). Sample No. S-58-Nebr-78-2-(1-8):

A1p—0 to 5 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; friable when moist; no effervescence; abrupt, smooth boundary.

A12—5 to 9 inches, very dark grayish-brown (10YR 3/2) loam, very dark brown (10YR 2/2) when moist; weak, coarse, subangular blocky structure breaking to weak, fine, granular structure; friable when moist; no effervescence; clear, smooth boundary.

A3—9 to 12 inches, dark-brown (7.5YR 4/2) clay loam, dark reddish brown (5YR 3/2) when moist; weak, coarse, subangular blocky structure breaking to moderate, fine and medium, granular structure; friable when moist; no effervescence; clear, wavy boundary.

B21—12 to 19 inches, reddish-brown (5YR 4/4) clay loam, reddish brown (5YR 4/4) when moist; weak, coarse, subangular blocky structure breaking to weak, fine and medium, subangular blocky structure; friable when moist; no effervescence; gradual, smooth boundary.

B22—19 to 28 inches, reddish-brown (5YR 5/4) loam, reddish brown (5YR 4/4) when moist; weak, coarse, prismatic structure breaking to weak, fine and medium, blocky structure; firm when moist; no effervescence; gradual, smooth boundary.

B23—28 to 40 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; weak, coarse, prismatic structure breaking to weak, medium and fine, subangular blocky structure; firm when moist; no effervescence; gradual, smooth boundary.

C1—40 to 51 inches, reddish-yellow (7.5YR 7/6) sandy loam, reddish yellow (7.5YR 6/6) when moist; weak, coarse, prismatic structure; friable when moist; no effervescence; clear, smooth boundary.

C2—51 to 60 inches, reddish-yellow (7.5YR 6/6) sandy loam, strong brown (7.5YR 5/6) when moist; massive; very friable when moist; no effervescence.

Muir series.—Soils in the Muir series are deep, dark colored, well drained, and weakly developed. They are Brunizems. Muir soils developed on nearly level stream terraces and high bottom lands that are no longer subject to flooding. A textural B horizon has not developed. Lime has been leached to a depth of 5 feet or more. Muir soils are intermediate in development between the Sharpsburg soils of the uplands and the Volin soils of the bottom lands. In Saunders County they have silty clay loam or silty clay substratum.

Profile of Muir silty clay loam (0.1 mile north and 75 feet east of the southwest corner of the northwest quarter of sec. 22, T. 13 N., R. 5 E.):

A1p—0 to 8 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; friable when moist; abrupt, smooth boundary.

A12—8 to 15 inches, very dark grayish-brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) when moist; weak, coarse, subangular blocky structure breaking to weak, fine, granular structure; friable when moist; noncalcareous; clear, smooth boundary.

A13—15 to 36 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure breaking to moderate, fine and medium, granular structure; friable when moist; noncalcareous; clear, smooth boundary.

A14—36 to 44 inches, dark grayish-brown (10YR 4/2) light silty clay, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure breaking to strong, fine and medium, granular structure; firm when moist; noncalcareous; abrupt, smooth boundary.

D1—44 to 60 inches +, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) when moist; weak, fine, granular structure to massive; firm when moist; noncalcareous.

Ortello series.—In the Ortello series are deep, well-drained Chernozems that intergrade toward Regosols. These soils developed in moderately sandy alluvium on stream terraces. A textural B horizon has not formed, but a color B horizon can be seen in many places. Ortello soils contain more sand than Muir and Monona soils.

The Ortello soils in Saunders County are principally in Todd Valley and on the sloping edges of the valley. They occur with Sharpsburg, Butler, and Fillmore soils and are similar to those soils because Peorian loess blanketed Todd Valley and the uplands in late Wisconsin

time. The Ortello soils are of minor extent in Saunders County.

Profile of Ortello loam in native sod on a slope of 7 percent (200 feet west and 60 feet south of the northeast corner of sec. 10, T. 14 N., R. 7 E.):

A11—0 to 3 inches, dark-gray (10YR 4/1) loam, very dark brown (10YR 2/2) when moist; weak, fine, crumb structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A12—3 to 14 inches, dark-gray (10YR 4/1) loam, very dark brown (10YR 2/2) when moist; weak, coarse, subangular blocky structure breaking to weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B2—14 to 24 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and coarse, subangular blocky structure; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

BC—24 to 34 inches, grayish-brown (10YR 5/2) fine sandy loam, dark brown (10YR 4/3) when moist; weak, medium and coarse, subangular blocky structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

C—34 to 39 inches, pale-brown (10YR 6/3) loamy sand, yellowish brown (10YR 5/4) when moist; massive; loose when dry and moist; noncalcareous; gradual, smooth boundary.

D—39 to 60 inches +, white (10YR 8/2) fine sand, light gray (10YR 7/2) when moist; massive.

Pawnee series.—Soils in the Pawnee series are dark-colored Brunizems that developed from till on moderately sloping and strongly sloping uplands. A clay B horizon has formed. In uneroded areas the surface layer is dominantly loess of silty clay loam texture. The boundary between the A and B horizons is abrupt. Pawnee soils occur with the Adair, Morrill, Shelby, Wymore, and Sharpsburg soils.

Profile of Pawnee clay loam (0.12 mile east and 125 feet north of the southwest corner of sec. 5, T. 13 N., R. 5 E.):

ABp—0 to 6 inches, clay loam, very dark brown (10YR 2.5/2) when moist; strong, medium, granular structure; slightly hard when dry, friable when moist; medium acid; abrupt, smooth boundary.

B1—6 to 10 inches, clay loam, very dark grayish brown (10YR 3/2) when moist; strong, fine, subangular and angular blocky structure; hard when dry, firm when moist; medium acid; clear, smooth boundary.

B21—10 to 20 inches, clay, dark brown (10YR 3/3) when moist; moderate, coarse, prismatic structure breaking to strong, medium, blocky structure; very hard when dry, very firm when moist; medium acid; gradual, smooth boundary.

B22—20 to 32 inches, clay, dark grayish brown (10YR 4/2) when moist; moderate, coarse, prismatic structure breaking to strong, medium, blocky structure; very hard when dry, very firm when moist; slightly acid; few, fine, strong-brown concretions of iron; abrupt, wavy boundary.

Cca—32 to 42 inches, clay loam, grayish brown (2.5Y 5/2) when moist; weak, medium and coarse, blocky structure; hard when dry, firm when moist; many, soft lime concretions; matrix noncalcareous in upper part, strongly calcareous in lower part.

Platte series.—The Platte series consists of imperfectly drained Alluvial soils that are shallow over gravel. The surface horizon is similar to that of Cass soils but is thicker than that of Sarpy soils. The gravelly substratum is nearer to the surface than in either Cass or Sarpy soils. Platte soils are inextensive in Saunders County. They are moderately well drained and imperfectly drained but are moderately well drained in most places.

Profile of Platte loam (0.3 mile north and 400 feet west of the southeast corner of sec. 18, T. 16 N., R. 9 E.):

A1p—0 to 9 inches, gray (10YR 5/1) loam, black (10YR 2/1) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A12—9 to 12 inches, gray (10YR 5/1) fine sandy loam, very dark gray (10YR 3/1) when moist; massive (structureless); soft when dry, very friable when moist; noncalcareous; clear, smooth to wavy boundary.

AC—12 to 16 inches, light brownish-gray (10YR 6/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; massive (structureless); loose when dry or moist; noncalcareous; abrupt, wavy boundary.

D—16 inches +, clean riverwash sand and gravel.

Rauville series.—The Rauville series consists of dark-colored, poorly drained and very poorly drained Humic Gley soils that developed in silty to clayey alluvium on nearly level bottom lands. The soil is wet most of the year. The water table is near the surface in winter and spring and drops to 3 or 4 feet below the surface late in summer. The Rauville soils occur with the Colo and Luton soils and are wetter than those soils but resemble them in color and texture.

Profile of Rauville silty clay loam (0.25 mile east and 120 feet south of the northwest corner of sec. 36, T. 13 N., R. 7 E.):

A1p—0 to 9 inches, dark-gray (10YR 4/1) heavy silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, platy structure; hard when dry, firm when moist; strongly calcareous; abrupt, smooth boundary.

A12—9 to 16 inches, dark-gray (10YR 4/1) heavy silty clay loam, very dark brown (10YR 2/2) when moist; common, distinct, gray and brown mottles; weak, fine and medium, granular structure; hard when dry, firm when moist; strong-brown iron stains along old root channels; clear, smooth boundary.

Cg1—16 to 34 inches, dark-gray (2.5Y 4/0) silty clay loam, black (10YR 2/1) when moist; moderate, medium, granular structure; hard when dry, firm when moist; strongly calcareous; abrupt, smooth boundary.

Cg2—34 to 48 inches, dark-gray (2.5Y 4/0) silty clay, black (10YR 2/1) when moist; massive; very hard when dry, very firm when moist; slightly calcareous.

Sarpy series.—The Sarpy series consists of Alluvial soils that developed in loamy sands on nearly level, well-drained or imperfectly drained bottom lands. The surface layer is very dark grayish brown or dark brown. It is dominantly loamy sand or fine sand but is silt loam, loam, or very fine sandy loam in small areas. The surface layer grades gradually to the subsoil, which is loamy sand in the upper part. The lower subsoil is generally fine sand or sand and grades abruptly to the substratum.

Profile of Sarpy loamy sand (0.15 mile east and 300 feet north of the southwest corner of the northwest quarter of sec. 30, T. 13 N., R. 10 E.):

A1—0 to 10 inches, dark grayish-brown (10YR 4/2) loamy sand, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; very friable when moist; noncalcareous; clear, smooth boundary.

AC—10 to 14 inches, gray (10YR 5/1) loamy sand, dark gray (10YR 4/1) when moist; weak, fine, granular structure; very friable when moist; noncalcareous; gradual, smooth boundary.

C1—14 to 40 inches, light-gray (10YR 7/2) fine sand, pale brown (10YR 6/3) when moist; single grain (structureless); loose when moist; noncalcareous; abrupt, wavy boundary.

D—40 inches +, coarse sand or sand and gravel.

Sharpsburg series.—Soils of the Sharpsburg series are

well-drained Brunizems that developed on nearly level to steeply sloping uplands from loess of Peorian age. They are the most extensive soils in the county. In the Todd Valley, Sharpsburg soils occur on nearly level and gentle slopes in association with Butler and Fillmore soils, which are in basins and swales. Throughout the rest of the county, Sharpsburg soils are on the ridgetops and side slopes. They have a less clayey B horizon than Wymore soils and a more clayey B horizon and more evident horizons than Monona soils.

The A horizon is dark-colored, medium acid silty clay loam. The transition to the B2 horizon is clear or gradual. An A3 or a B1 horizon occurs in all areas. The B2 horizon contains more clay than the A horizon, though both horizons are silty clay loam. The B2 horizon is medium acid in the upper part and slightly less acid in the lower part. It has subangular blocky or blocky structure and many angular peds. The B2 horizon swells when moisture content increases and shrinks when it decreases. The substratum is loess of Peorian age. That loess most recently deposited is pale brown, free of mottles and stains, and generally calcareous. In many places loess of middle and early Peorian age is gray, olive gray, or olive brown and contains concretions and stains of iron and manganese.

Profile of Sharpsburg silty clay loam (0.2 mile north and 50 feet east of the southwest corner of the northwest quarter of sec. 17, T. 16 N., R. 6 E.). Sample No. S–58–Nebr–78–6–(1–11):

A1p—0 to 6 inches, very dark grayish-brown (10YR 3/2) light silty clay loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; friable when moist; no effervescence; abrupt, smooth boundary.

B1—6 to 10 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure breaking to moderate, fine, subangular blocky structure; friable when moist; no effervescence; clear, smooth boundary.

B21—10 to 18 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; weak, coarse, subangular blocky structure breaking to moderate, medium, subangular blocky structure; firm when moist; no effervescence; thin, continuous clay coatings on aggregates; gradual, smooth boundary.

B22—18 to 27 inches, brown (10YR 5/3) silty clay loam, dark grayish-brown (10YR 4/2) when moist; few, fine, faint, dark-brown mottles; moderate, medium, prismatic structure breaking to moderate, fine and medium, blocky structure; slightly plastic when wet; no effervescence; thin, continuous clay coatings on aggregates; gradual, smooth boundary.

B3—27 to 32 inches, brown (10YR 5/3) silty clay loam, dark grayish brown (10YR 4/2) when moist; few, fine, faint, yellowish-brown mottles; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky structure; slightly plastic when wet; no effervescence; thin, patchy clay coatings; clear, smooth boundary.

C1—32 to 40 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; common, fine and medium, distinct, yellowish-brown mottles; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky structure; friable when moist; no effervescence; scattered dark-brown iron and manganese concretions; gradual, smooth boundary.

C2—40 to 50 inches, light brownish-gray (2.5Y 6/2) light silty clay loam, grayish brown (2.5Y 5/2) when moist; common, fine and medium, distinct, yellowish-brown mottles; weak, coarse, prismatic structure; friable when moist; no effervescence; scattered dark-brown iron and manganese concretions; gradual, smooth boundary.

C3—50 to 60 inches, light brownish-gray (2.5Y 6/2) light silty clay loam, grayish brown (2.5Y 5/2) when moist; common, fine and medium, distinct, yellowish-brown mottles; weak, coarse, prismatic structure; friable when moist; no effervescence; scattered dark-brown iron and manganese concretions; gradual, smooth boundary.

C4—60 to 84 inches, light yellowish-brown (2.5Y 6/4) light silty clay loam, light olive brown (2.5Y 5/4) when moist; common, fine, distinct, gray and yellowish-brown mottles; high percentage of gray mottles; weak, coarse, prismatic structure; very friable when moist; no effervescence; gradual, smooth boundary.

C5—84 to 93 inches, light yellowish-brown (2.5Y 6/4) light silty clay loam, light olive brown (2.5Y 5/4) when moist; common, fine, distinct, gray and yellowish-brown mottles; high percentage of yellowish-brown mottles; weak, coarse, prismatic structure; very friable when moist; no effervescence; gradual, smooth boundary.

C6—93 to 120 inches, light-gray (2.5Y 7/2) light silty clay loam, grayish brown (2.5Y 5/2) when moist; common, fine, distinct, gray and yellowish-brown mottles; weak, coarse, prismatic structure; very friable when moist; no effervescence.

Shelby series.—Soils in the Shelby series are well-drained Brunizems that developed in till. They are inextensive in Saunders County, where they have been mapped in units with Burchard soils. The Burchard soils developed from similar parent materials. Shelby soils have a thicker B horizon than Burchard soils and have been leached of lime to a greater depth, or 40 inches or more below the surface. In this county Shelby soils occur with the Pawnee, Adair, Morrill, and Steinauer soils. Their subsoil is less clayey than that of the Adair and Pawnee soils. Shelby soils are similar to Morrill soils in thickness of the solum and have the same kind and number of horizons, but Morrill soils contain more sand and gravel. The Shelby and Steinauer soils developed from the same kind of parent material, but the Steinauer soils are Regosols.

Profile of Shelby clay loam in a cultivated field on a slope of 7 percent (0.1 mile east and 70 feet south of the northwest corner of sec. 34, T. 13 N., R. 5 E.):

A1p—0 to 7 inches, very dark grayish-brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

A12—7 to 10 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak fine structure; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

B21—10 to 23 inches, brown (10YR 5/3) heavy clay loam, dark brown (10YR 4/3) when moist; weak, coarse, subangular blocky structure breaking to moderate, fine and medium, granular structure; hard when dry, firm when moist; noncalcareous; clear, smooth boundary.

B22—23 to 30 inches, yellowish-brown (10YR 5/4) heavy clay loam, dark yellowish brown (10YR 4/4) when moist; weak, coarse, subangular blocky structure breaking to moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist; noncalcareous; clear, smooth boundary.

B3—30 to 35 inches, strong-brown (7.5YR 5/6) heavy clay loam, yellowish brown (10YR 5/6) when moist; weak, fine, granular structure; hard when dry, firm when moist; noncalcareous; clear, smooth boundary.

C1—35 to 44 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) when moist; many, medium and coarse, distinct, yellowish-brown and reddish-brown mottles; massive; extremely hard when dry, very firm when moist; noncalcareous; abrupt, smooth boundary.

Cca—44 to 50 inches, light brownish-gray (2.5Y 6/2) clay loam, light olive brown (2.5Y 5/6) when moist; many, coarse, prominent, yellowish-brown and reddish-brown mottles; massive; hard when dry, very firm when moist; violent effervescence; many, soft lime concretions.

Steinauer series.—Soils of the Steinauer series are well-drained Regosols that developed in calcareous till. They occur on steep and very steep slopes and on very narrow ridgetops in the dissected loess-till plain, chiefly in the southwestern part of the county. They are more weakly developed than the associated Burchard soils. Steinauer soils are calcareous at or near the surface. The dark-colored surface layer grades gradually to the slightly weathered grayish and yellowish-brown calcareous till.

Profile of Steinauer clay loam on a slope of 14 percent in native sod (250 feet east and 150 feet north of the southwest corner of sec. 7, T. 13 N., R. 5 E.):

A1—0 to 6 inches, dark-gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) when moist; weak, fine and very fine, crumb structure; very friable when moist; slightly calcareous; clear, smooth boundary.

AC1—6 to 10 inches, grayish-brown (10YR 5/2) clay loam, dark brown (10YR 3/3) when moist; weak, medium and fine, subangular blocky structure breaking to moderate, fine, granular structure; friable when moist; strongly calcareous; gradual, smooth boundary.

AC2—10 to 22 inches, brown (10YR 5/3) clay loam, dark yellowish brown (10YR 4/4) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky structure; friable when moist; very strongly calcareous; clear, smooth boundary.

C—22 to 36 inches, light brownish-gray (2.5Y 6/2) clay loam, light olive brown (2.5Y 5/4) when moist; common, distinct, yellowish-brown mottles; moderate, fine and coarse, blocky structure; firm when moist; very strongly calcareous; many lime concretions.

Volin series.—The Volin series consists of moderately well drained and well drained Alluvial soils that developed in loamy alluvium, principally on the flood plain of the Platte River. They are higher and better drained than the Leshara soils and have a finer textured and more coherent subsoil than the Cass soils. Volin soils are seldom flooded and in some areas have remained stable long enough to acquire some characteristics slightly like those of zonal soils. In most areas a B horizon has not formed, but in some places the soils have a weak color and structural B horizon. In most places a buried soil occurs below the solum of Volin soils.

Profile of Volin silt loam (0.25 mile south and 50 feet east of the northwest corner of sec. 25, T. 13 N., R. 9 E.):

A1p—0 to 6 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) when moist; weak, thick, platy structure breaking to moderate, fine, granular structure; soft when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

A12—6 to 10 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) when moist; weak, coarse, subangular blocky structure breaking to strong, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; many fine and medium pores and openings; clear, smooth boundary.

AC—10 to 17 inches, grayish-brown to light brownish-gray (10YR 5/2 and 6/2) silt loam, dark grayish brown and grayish brown (10YR 4/2 and 5/2) when moist; moderate, coarse, granular structure breaking to strong, medium and fine, granular structure; slightly hard when dry, friable when moist; many fine pores and openings; noncalcareous; clear, smooth boundary.

C1—17 to 23 inches, light brownish-gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) when moist; massive; soft when dry, very friable when moist; many fine pores and openings; noncalcareous; clear, smooth boundary.

C2—23 to 32 inches, light-gray (2.5Y 7/2) very fine sandy loam, grayish brown (2.5Y 5/2) when moist; massive; soft when dry, very friable when moist; many medium and fine pores and openings; noncalcareous; clear, smooth boundary.

C3—32 to 43 inches, light-gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) when moist; very few, coarse, brown mottles; some worm casts; massive; soft when dry, very friable when moist; many medium and fine pores and openings; violent effervescence; many fine white streaks and spots of lime; clear, smooth boundary.

C4—43 to 60 inches, light-gray (10YR 7/1) silt loam and sandy loam stratified with very thin lenses of nearly white very fine sandy loam and nearly black silty clay loam, gray (10YR 5/1) when moist; massive; soft when dry, very friable when moist; weak effervescence.

Wann series.—In the Wann series are imperfectly drained Alluvial soils that developed in sandy alluvium. In Saunders County these soils occur principally on the flood plain of the Platte River. The substratum is sand or sand and gravel and is saturated much of the time by a water table that fluctuates several feet during the year. The ground water moves downward toward the Platte River and down the valley. In some areas where alkali salts have accumulated, the water table is relatively stable and there is little lateral movement of the ground water.

The surface layer is dark colored (generally of chroma not more than 1), and it is calcareous in many places. The subsoil is generally strongly calcareous and indistinctly mottled in the lower part. Three phases of the Wann soils are shown on the soil map. The moderately deep and deep phases are modal Wann soils. The alkali phase is not within the range of Wann soils as described and is a variant of the series.

Profile of Wann fine sandy loam, deep (0.25 mile south and 0.1 mile east of the northwest corner of the northeast quarter of sec. 13, T. 13 N., R. 9 E.):

A1p—0 to 8 inches, dark-gray (10YR 4/1) fine sandy loam, black (10YR 2/1) when moist; weak, fine, granular structure; very friable when moist; weakly calcareous; abrupt, smooth boundary.

AC—8 to 13 inches, dark grayish-brown (10YR 5/2) fine sandy loam, very dark brown (10YR 2/2) when moist; weak, coarse, subangular blocky structure; very friable when moist; weakly calcareous; clear, smooth boundary.

C1—13 to 34 inches, light-gray (2.5Y 7/2) fine sandy loam, grayish brown (2.5Y 5/2) when moist; common, fine and medium, distinct, yellowish-brown mottles; weak, coarse, subangular blocky structure; very friable when moist; strongly calcareous; abrupt, wavy boundary.

C2—34 to 37 inches, dark grayish-brown (2.5Y 4/2) light silty clay loam, very dark grayish brown (2.5Y 3/2) when moist; common, fine and medium, distinct, yellowish-brown mottles; moderate, fine, granular structure; firm when moist; strongly calcareous; abrupt, wavy boundary.

C3—37 to 50 inches, light brownish-gray (2.5Y 6/2) loamy sand, dark grayish brown (2.5Y 4/2) when moist; common, fine and medium, distinct, yellowish-brown mottles; massive; loose when moist; slightly calcareous; abrupt boundary.

C4—50 inches +, fine and medium sand.

Wymore series.—Soils in the Wymore series are well-drained Brunizems that developed on nearly level to steeply sloping uplands in Peorian loess. They are inextensive in Saunders County and occur principally in

the southwestern part, where they are mapped in units with Sharpsburg soils.

The A horizon is dark-colored, medium acid silty clay loam. The transition to the B horizon is clear or gradual. These soils have an A3 or B1 horizon. The B2 horizon is a silty clay that is medium acid in the upper part and slightly less acid in the lower part. A dark-colored film coats the ped surfaces, and structure is blocky. The lower part of the B horizon is mottled or stained with yellowish brown, strong brown, and dark brown. The substratum is gray loess stained with yellowish brown and dark brown. It is calcareous in some places.

Profile of Wymore silty clay loam (sec. 17, T. 13 N., R. 6 E.):

A1p—0 to 6 inches, dark-gray (10YR 4/1) silty clay loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; friable when moist; medium acid; abrupt, smooth boundary.

B1—6 to 12 inches, very dark grayish-brown (10YR 3/2) silty clay, very dark grayish brown (10YR 3/2) when moist; moderate, very fine, blocky structure; firm when moist; medium acid; clear, smooth boundary.

B21—12 to 18 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) when moist; moderate, medium and fine, blocky structure; firm when moist; thin clay coatings on most aggregate faces; medium acid; clear, smooth boundary.

B22—18 to 26 inches, dark-brown (10YR 4/3) silty clay, dark grayish-brown (10YR 4/2) when moist; few, medium, faint, yellowish-brown mottles; moderate, medium and fine, blocky structure; firm when moist; thin clay coatings on most aggregate faces; few, distinct, fine, very dark brown iron concretions; gradual, smooth boundary.

B23—26 to 33 inches, light olive-brown (2.5Y 5/3) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; common, fine and medium, yellowish-brown mottles; weak, coarse, prismatic structure breaking to weak, medium, blocky structure; firm when moist; slightly acid; thin to medium clay coatings on vertical faces of some aggregates; common, distinct, fine, very dark brown and reddish-brown iron concretions; gradual, smooth boundary.

B3—33 to 42 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, blocky structure; firm when moist; neutral; few, medium to thick clay films along surfaces of weakness, which open when the soil dries; many, distinct, fine and medium, yellowish-brown, strong-brown, and very dark brown iron concretions and stains; gradual, smooth boundary.

C—42 to 60 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; weak, coarse and medium, blocky structure; friable when moist; neutral; few, medium to thick clay films along surfaces of weakness, which open when the soil dries; many, distinct, strong-brown and very dark brown iron concretions and stains.

Mechanical and Chemical Analyses

The data obtained by mechanical and chemical analyses for some selected soils in Saunders County are given in table 7. Profiles of the selected soils are described in the section "Formation and Classification of Soils," beginning on page 61. The data in table 7 are useful to soil scientists in classifying soils and in developing concepts of soil genesis. They are also helpful for estimating water-holding capacity, wind erosion, fertility, tilth, and other characteristics that affect soil management. The data on reaction, electrical conductivity, and percentage of exchangeable sodium are helpful in evaluating the possibility of reclaiming and managing saline-alkali areas.

Field and Laboratory Methods

All samples used to obtain the data in table 7 were collected from carefully selected sites. The samples are considered representative of the soil material that is made up of particles less than ¾ inch in diameter. Estimates of the fraction of the sample consisting of particles larger than ¾ inch were made during the sampling. If necessary, the sample was sieved after it was dried and rock fragments larger than ¾ inch in diameter were discarded. Then the material made up of particles less then ¾ inch was rolled, crushed, and sieved by hand to remove rock fragments larger than 2 millimeters in diameter. The fraction that consists of particles between 2 millimeters and ¾ inch in diameter is recorded on the data sheets and in table 7 as the percentage larger than 2 millimeters. This value is calculated from the total weight of the particles smaller than ¾ inch in diameter.

The content given for the fractions that consist of particles larger than ¾ inch and of particles between 2 millimeters and ¾ inch is somewhat arbitrary. The accuracy of the data depends on the severity of the preparative treatment, which may vary with the objectives of the study. But it can be said that the two fractions contain relatively unaltered rock fragments that are larger than 2 millimeters in diameter and that they do not contain slakable clods of earthy material.

Unless otherwise noted, all laboratory analyses are made on material that passes the 2-millimeter sieve and are reported on an oven-dry basis. In table 7, values for extractable sodium and potassium are for amounts of sodium and potassium that have been extracted by the ammonium acetate method minus the amounts that are soluble in the saturation extract.

Standard methods of the Soil Survey Laboratory were used to obtain most of the data in table 7. Determinations of clay were made by the pipette method (*5*, *6*, *7*). The reaction of the saturated paste was measured with a glass electrode. Organic carbon was determined by wet combustion, using a modification of the Walkley-Black method (*8*). The calcium carbonate equivalent was determined by measuring the volume of carbon dioxide emitted from soil samples treated with concentrated hydrochloric acid. The cation exchange capacity was determined by direct distillation of adsorbed ammonia (*8*). To determine the extractable calcium and magnesium, calcium was separated as calcium oxalate and magnesium as magnesium ammonium phosphate (*8*). Extractable sodium and potassium were determined on original extracts with a flame spectrophotometer. The methods of the U.S. Salinity Laboratory were used to obtain the saturation extract (*9*). Soluble sodium and potassium were determined on the saturation extract with a flame spectrophotometer.

General Nature of the County

This section was prepared mainly for those not familiar with the county. It contains information on history, natural resources, and industry; relief and drainage; transportation and markets; climate; and agriculture.

History, Natural Resources, and Industry

The Otoe Indians lived in the territory that is now Saunders County before the first pioneers settled north of Ashland in 1856. Ashland was voted the county seat in October 1866, but the county seat was moved to Wahoo on October 14, 1873. The early settlers were plagued by droughts, grasshoppers, and hard times.

The early settlers plowed their soils and grew corn, wheat, and garden crops for home use. When transportation facilities opened up new markets, farmers were able to market some of their products. The acreage planted to corn and wheat increased, and cattle and hogs were raised and marketed. Eventually all of the land came into use. Today only a few areas of native prairie remain, because most of it was plowed so that cultivated crops could be grown. Corn, oats, wheat, and alfalfa have been important crops for many years. As the demand for agricultural products changed, new crops were introduced in the area. Soybeans and grain sorghum have become important in recent years. Bromegrass is widely used for pasture.

The size of the farms has increased, but most farms remain family size. Raising and feeding of livestock is an important part of the agricultural economy. A few farms are principally livestock farms, but most are grain-livestock farms on which a part or all of the feed grain produced is fed to cattle and hogs. A few are cash-grain farms.

Fertile soil is the most valuable natural resource of Saunders County. Next is the ground-water supply, which is adequate for domestic and livestock use throughout the county and for irrigation and industrial plants in about one-third of the county. Rock is quarried near Ashland, and gravel and sand suitable for construction are obtained from materials underlying the lowlands along the Platte River.

Most of the soils in Saunders County are suitable for cultivation. They are deep, loamy, and of moderate or high fertility. Only a small acreage is steep, and this is or probably should be in permanent vegetation. The climate is favorable for growing many kinds of crops. Moderately high yields of corn, wheat, oats, grain sorghum, alfalfa, and soybeans are obtained under dryland management. High yields can be obtained under irrigated management. The soils in the Todd Valley area are well suited for irrigation, and the supply of ground water is adequate. In some areas the change from dryland to irrigated farming is being made.

The county is expected to remain an agricultural area in which most of the farms continue as combination cash-grain and livestock units. Mechanization is expected to continue, and the size of the farms may continue to increase. However, this trend probably will be slowed as opportunities for employment off the farm increase. Irrigation is expected to increase in the bottom lands and in Todd Valley. Additional industry probably will be attracted to the area by its plentiful ground water, its geographic location, its transportation facilities, and its proximity to the larger towns of the State. Recreational areas are expected along the Platte River and along the chain of lakes that were made when sand and gravel were excavated. Although Saunders County remains primarily agricultural, it no longer entirely depends on agriculture. Improved farming methods and new crop varieties have increased and stabilized yields. Insect pests and drought no longer mean hunger and hard times.

Relief and Drainage

Relief of the county ranges from nearly level to very steeply sloping and blufflike. Slopes of 4 to 9 percent that are 200 to 800 feet long predominate. The longer, more gradual slopes are farthest from the larger, most deeply entrenched streams or drainageways. The shorter, steeper slopes border the drainageways.

In the uplands that border the Platte River, most slopes exceed 20 percent and some are blufflike. In the hilly areas in the southwestern part of the county, slopes range from 6 to 17 percent and are 150 to 400 feet long. These slopes are shorter and steeper than average. Most slopes of less than 2 percent are on the bottom lands and terraces. The only nearly level areas in the uplands are on the broadest divides. Only a few of these areas are larger than 100 acres.

The Todd Valley terrace is nearly level to gently undulating. It slopes gradually southeastward, falling approximately 7 feet to the mile. The surface of this terrace is comparatively smooth, but there is a series of shallow depressions and small mounds that formed largely when the wind shifted the surface soil.

Drainage is chiefly southeastward through Wahoo Creek and its principal tributaries, Dunlap, Cottonwood, Duck, and Sand Creeks and Miller Branch. Rock Creek and Oak Creek drain the southern and southwestern parts of the county. These creeks flow southward and empty into Salt Creek in Lancaster County. Wahoo Creek flows into Salt Creek just north of Ashland, and Salt Creek flows into the Platte River east of Ashland near the southeastern corner of the county. The small drains along the bluffs in the northern and eastern parts of the county drain directly into the Platte River.

In most places drainage is adequate for the crops commonly grown. Only a small acreage is too wet or too excessively drained for cultivation.

Transportation and Markets

The Union Pacific Railroad enters the county near the southwestern corner and runs through Valparaiso, Touhy, Weston, Wahoo, Mead, and Yutan before leaving the county northeast of Yutan. The Chicago and North Western Railway enters the county south of Ceresco, serves the towns of Ceresco, Swedeburg, Wahoo, Colon, and Cedar Bluffs, and crosses the Platte River north of Cedar Bluffs into Dodge County. It has a branch line across the northern part of the county. This branch serves Morse Bluff and leaves the county near the northeastern corner. A main line of the Chicago, Burlington and Quincy Railroad crosses the county diagonally from southeast to northwest and serves Ashland, Memphis, Ithaca, Wahoo, Malmo, and Prague. Another branch runs in the eastern part of the county and serves Ashland, Wann, Yutan, and Leshara.

U.S. Highway No. 30-A crosses the county from east to west, and U.S. Highway No. 77 crosses it from north to south. All towns in the county are connected by State or county gravel roads. On most section lines are dirt or gravel roads that are maintained by the county.

TABLE 7.—*Analytical data*

[Analysis of Burchard, Morrill, and Sharpsburg profiles made at Soil Survey Laboratory, Soil Conservation Service, Lincoln, Nebraska. of figures indicates

Soil	Horizon	Depth	Particle-size distribution: Very coarse sand (2–1 mm.)	Coarse sand (1–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Silt (0.05–0.002 mm.)	Clay (<0.002 mm.)	Coarse fragments (>2 mm.)
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Burchard clay loam: *Location:* 1,100 feet S. and 30 feet W. of NE. cor., sec. 30, T. 13 N., R. 6 E. (*Sample No.* S-58-Nebr-78 1-(1-8); *laboratory No.* 8414-8421).	Alp	0–6	2.1	4.4	6.4	14.3	10.4	36.7	25.7	2.3
	A12	6–9	3.7	5.8	5.4	11.0	7.6	30.8	35.7	3.6
	B21	9–13	2.4	5.4	5.6	11.1	7.0	29.9	38.6	([1])
	B22	13–20	1.3	4.7	5.4	11.1	8.1	31.1	38.3	([1])
	B3ca	20–24	[2] 2.6	[2] 4.5	[2] 4.6	[2] 10.2	[2] 8.2	38.3	31.6	([1])
	C1	24–36	[2] 2.4	[2] 4.2	[2] 4.5	[2] 10.4	[2] 8.0	37.3	33.2	6.6
	C2	36–48	[2] 2.4	[2] 4.4	[2] 4.7	[2] 10.7	[2] 8.1	37.2	32.5	5.7
	C3	48–60	[2] 1.7	[2] 4.3	[2] 4.9	[2] 10.8	[2] 8.3	36.5	33.5	([1])
Cass fine sandy loam, deep: *Location:* 500 feet N. and 100 feet W. of SE. cor., sec. 25, T. 14 N., R. 9 E. (*Sample No.* S-53-Nebr-4-(1-6); *laboratory No.* 1498-1503).	Alp	0–6	.4	2.8	7.8	25.4	22.0	30.6	11.0	.1
	A12	6–15	.2	2.6	8.9	29.0	21.7	27.4	10.2	----
	AC	15–22	.2	3.0	10.2	32.7	19.2	26.3	8.4	----
	C1	22–29	.2	2.2	9.3	36.5	13.3	31.9	6.6	----
	C2	29–36	.2	2.1	10.1	43.7	24.0	15.6	4.3	----
	C3	36–49	.2	2.0	10.5	38.8	31.0	13.8	3.7	----
Leshara silt loam, deep: *Location:* 500 feet S. and 50 feet W. of NE. cor., NW¼, sec. 25, T. 13 N., R. 9 E. (*Sample No.* S-53-Nebr-78-3-(1-8); *laboratory No.* 1490-1497).	Alp	0–6	----	----	----	.5	18.1	64.4	17.0	----
	A12	6–10	----	----	----	.2	17.1	63.2	19.5	----
	AC	10–13	----	----	----	.2	18.4	64.2	17.2	----
	C1	13–19	----	----	.2	1.0	27.5	60.4	10.9	----
	C2	19–26	----	----	.1	.3	22.7	67.6	9.3	----
	Cca	26–32	.2	.3	.1	.2	4.5	78.2	16.5	----
	C3	32–46	----	----	.1	.6	27.5	65.6	6.2	----
	C4	46–52	.1	.1	.1	.9	4.6	48.4	45.8	----
Morrill loam: *Location:* 160 feet E. and 40 feet N. of SW. cor., SE¼, sec. 15, T. 13 N., R. 6 E. (*Sample No.* S-58-Nebr-78-2-(1-8); *laboratory No.* 8422-8429).	A1p	0–5	1.7	5.0	4.3	10.3	8.0	48.5	22.2	([1])
	A12	5–9	.7	5.0	4.1	8.8	7.7	47.6	26.1	([1])
	A3	9–12	3.1	6.9	3.9	3.9	11.2	41.6	29.4	([1])
	B21	12–19	2.8	8.1	3.9	4.0	12.8	36.7	31.7	([1])
	B22	19–28	5.5	12.1	4.9	5.2	16.2	29.6	26.5	([1])
	B23	28–40	8.4	13.8	5.6	7.0	19.2	24.8	21.2	([1])
	C1	40–51	8.5	13.8	6.8	7.1	24.9	22.1	16.8	([1])
	C2	51–60	8.0	23.7	10.3	9.7	24.1	13.1	11.1	3.1
Sharpsburg silty clay loam: *Location:* 0.2 mile N. and 50 feet E. of SW. cor., NW¼, sec. 17, T. 16 N., R. 6 E. (*Sample No.* S-58-Nebr-78-6-(1-11); *laboratory No.* 8457-8467).	A1p	0–6	<.1	[3].1	[3].1	[3].3	[4]6.0	63.7	29.8	----
	B1	6–10	[3].1	[3].2	[3].1	[3].1	[4]4.4	57.2	37.9	----
	B21	10–18	<.1	[3].2	[3].2	[3].3	[4]4.3	53.6	41.4	----
	B22	18–27	[3].1	[3].1	[3].1	[3].3	[4]6.1	57.1	36.2	----
	B3	27–32	<.1	[3].1	[3].1	[3].3	8.0	58.1	33.4	----
	C1	32–40	<.1	.1	.1	.4	8.3	59.2	31.9	----
	C2	40–50	[3].1	[3].1	[3].1	[3].5	[4]7.2	59.6	32.4	----
	C3	50–60	<.1	[3].1	[3].1	[3].5	[4]5.7	62.6	31.0	----
	C4	60–84	[3].1	[3].2	[3].2	[3].5	[4]7.0	64.2	27.8	----
	C5	84–93	<.1	[3].4	[3].4	[3].8	[4]6.5	65.4	26.5	----
	C6	93–120	<.1	[3].2	[3].1	[3].5	[4]5.6	66.2	27.4	----

[1] Trace.

[2] Common calcium carbonate concretions.

for selected soil profiles

Analysis of Cass and Leshara profiles made at Soil Survey Laboratory, Soil Conservation Service, Mandan, North Dakota. Absence values not determined]

Texture	Chemical analysis											
	Reaction (pH), saturated paste	Organic carbon	Electrical conductivity Ec x 10^3 mhos. per cm. at 25° C.	$CaCO_3$ equivalent	Cation exchange capacity (NH_4 Ac)	Extractable cations					Base saturation (NH_4Ac)	Moisture at saturation
						Ca	Mg	H	Na	K		
		Percent		*Percent*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*	*Percent*	*Percent*
Clay	5.7	2.02	0.4	--------	20.7	14.8	3.6	7.3	<0.1	0.5	91	48.8
Clay	5.7	1.64	.4	--------	26.0	20.0	3.9	6.6	<.1	.4	93	59.5
Clay	6.0	1.10	.4	--------	28.6	23.6	3.5	5.4	.1	.4	96	60.0
Clay	6.7	.60	.5	<1	27.7	26.0	3.0	4.6	.1	.4	106	63.5
Clay	8.0	.43	.5	15	20.8	------	------	<.1	.1	.3	--------	55.6
Clay	8.1	.20	.5	12	20.0	------	------	<.1	.1	.3	--------	57.3
Clay	8.1	.05	.5	14	19.8	------	------	<.1	.1	.3	--------	59.1
Clay	8.0	.03	.5	11	18.4	------	------	<.1	.2	.4	--------	61.7
Fine sandy loam	5.6	1.23	.4	--------	11.5	6.3	2.3	----	.2	1.0	--------	30.3
Fine sandy loam	5.8	.88	.4	--------	10.6	7.2	1.6	------	.1	.1	--------	33.1
Fine sandy loam	6.3	.60	.4	--------	8.7	6.5	1.2	------	.1	.1	--------	30.6
Fine sandy loam	6.4	.33	.4	--------	6.7	5.1	1.0	------	.1	.1	--------	24.8
Loamy fine sand	6.6	.14	.4	--------	4.5	3.5	.6	------	.1	.1	--------	24.2
Loamy fine sand	6.8	.05	.6	------	3.7	3.4	.6	------	------	.1	------	25.9
Silt loam	6.2	1.31	.6	--------	17.0	11.4	3.9	------	.1	1.3	--------	42.8
Silt loam	5.9	1.18	.4	--------	19.4	12.5	4.2	------	.4	.9	--------	47.8
Silt loam	6.3	.74	.4	--------	16.3	11.2	4.1	------	.4	.6	--------	47.3
Silt loam	6.4	.31	.4	--------	11.7	8.6	3.6	------	.2	.3	--------	41.1
Silt loam	7.0	.24	.4	--------	11.1	7.4	3.6	------	.5	.4	--------	41.8
Silt loam	7.9	.46	.6	4	18.8	35.3	7.5	------	.5	.8	--------	50.8
Silt loam	8.0	.08	.6	1	9.0	17.7	4.8	------	.5	.3	--------	40.8
Silty clay	7.7	.02	.7	3	34.2	42.4	16.8	------	2.1	1.0	--------	74.3
Loam	5.4	1.32	.4	--------	14.2	7.8	3.2	7.3	<.1	.6	82	43.6
Loam	5.9	1.38	.4	--------	16.6	10.4	4.2	6.1	<.1	.4	90	52.8
Clay loam	6.2	1.11	.4	--------	18.7	11.6	5.5	5.3	.1	.4	94	53.8
Clay loam	6.2	.59	.3	--------	18.6	11.3	6.0	4.9	.1	.4	96	58.0
Loam	6.3	.34	.4	--------	15.9	9.7	5.7	4.1	.1	.3	99	56.2
Sandy clay loam	6.5	.17	.4	--------	13.4	8.3	4.7	2.8	.1	.2	99	48.7
Sandy loam	6.6	.08	.4	<1	11.8	7.4	4.2	1.6	.1	.2	101	42.8
Coarse sandy loam	7.0	.03	.4	<1	8.2	5.1	2.8	2.0	.1	.2	100	27.8
Silty clay loam	5.8	1.54	.4	--------	20.3	11.8	4.1	7.7	<.1	1.4	85	51.2
Silty clay loam	5.8	1.24	.4	--------	24.3	14.8	6.0	7.4	<.1	.8	89	60.1
Silty clay	6.1	.69	.4	--------	27.1	17.0	7.5	6.2	.1	.7	93	66.5
Silty clay loam	6.2	.34	.4	--------	25.0	16.5	7.3	5.0	.1	.7	98	63.6
Silty clay loam	6.2	.26	.4	--------	23.7	16.1	6.8	4.5	.1	.7	100	65.9
Silty clay loam	6.4	.21	.3	--------	23.8	16.1	6.8	3.7	.2	.7	100	71.3
Silty clay loam	6.5	.13	.5	--------	24.5	17.3	7.2	2.9	.3	.9	105	63.3
Silty clay loam	6.6	.12	.5	<1	23.6	16.8	6.8	2.5	.3	1.0	106	62.4
Silty clay loam	6.9	.09	.4	<1	23.1	16.4	6.9	2.0	.3	1.1	107	55.8
Silty clay loam	7.0	.08	.4	<1	23.5	16.7	7.2	2.5	.3	1.2	108	55.8
Silt loam	7.1	.04	.4	<1	21.4	15.5	6.9	1.2	.3	1.2	112	50.8

[3] Many, smooth, brown to black concretions, possibly of iron and manganese.

[4] Few, smooth, brown to black concretions, possibly of iron and manganese.

Excellent market facilities are available at Wahoo in Saunders County and in the larger Nebraska cities of Omaha, Lincoln, and Fremont, which are less than an hour's drive from almost any point in the county.

Climate [7]

Saunders County, like the rest of eastern Nebraska, is near the center of a large landmass and is far from any large bodies of water. This part of the Great Plains is open to the north and south, and cold northerly or hot southerly winds are not obstructed. Because the Rocky Mountains obstruct westerly winds, southerly winds tend to dominate in the summer and northerly winds in the winter, though there are frequent reversals of direction. Consequently, the summers are hot and winters are cold. The temperature changes from day to day are frequently large, particularly during winter and early in spring. The average temperature of the coldest month, January, is 23.7° F., and of the warmest month, July, is 77.8°, a difference of 54.1°.

The coldest month on record at Ashland was February 1936, when the average temperature was only 7°. In 1936, minimum temperatures were below zero for 33 consecutive days beginning on January 18, and the average mean temperature for the 31-day period beginning January 19 was 4.1° below zero. Although the average snowfall is fairly light, one or two severe snowstorms usually occur each winter, and their strong winds cause much blowing and drifting. Snow covers the ground most of the time in January. In February, however, the sun gets high enough to melt the snow, and the snow cover comes and goes. At other times in winter, there are dry westerly winds; days are mild, and temperatures drop to a little above or below freezing at night.

During spring warm, moist, southerly winds are more frequent, and the precipitation increases. Early in spring the cold air from the north meets the warm mild air from the south, and the temperature changes are sharp. The intensity of the cold air lessens as spring advances, and cool periods are less frequent.

Dominating the weather in summer are air masses from the Gulf of Mexico and air masses that orginate in the desert regions to the southwest. When the air is from the gulf, humidity is high, temperatures are high but not excessively high, and showers or thunderstorms are frequent. The southwesterly desert air brings very high temperatures, low humidity, and little or no moisture. This desert air was dominant during the summers of 1934 and 1936 and caused the most severe droughts on record. In July 1934, the average temperature was 86.2° F., and 19 days had afternoon temperatures of 100° or higher. The temperature reached 116° on July 20, and 2 days later did not drop below 85° during the night. Occasionally in summer cool, rather dry air comes from the north.

Cool air occurs more frequently in the county during fall. September 12 is the earliest date recorded for the first freezing temperature in fall. The chance of a freezing temperature on or before October 9 is 50 percent at Ashland. In the northwestern corner of the county, however, this chance of 50 percent is about 3 days earlier. Dry, sunny days and crisp nights are common late in October and in much of November because the warm, moist air from the gulf reaches the county less frequently. This kind of weather is very favorable for the corn harvest.

Table 8 shows that the average annual precipitation at Wahoo, near the center of the county, is about 27 inches. Of this amount about 74 percent normally falls during the growing season, which is from April through September.

Also listed in table 8 for a 30-year period is the average precipitiation for each month of the year. By using a longer period that gives the percentage of months in which precipitation was less than half of the monthly average in the 30-year period, a farmer can get an idea of the chance that drought will severely damage crops in any month of the growing season, and he can estimate the months in which water storage will be low. The list

[7] By RICHARD E. MYERS, State climatologist, U.S. Weather Bureau.

TABLE 8. *Precipitation data for Wahoo, Nebr.*

Month	Average precipitation [1]	Precipitation in driest month [2]	Precipitation in wettest month [2]	Greatest precipitation in 24 hours [3]	Average snowfall [4]
	Inches	*Inch*	*Inches*	*Inches*	*Inches*
January	0.97	0.02 (1943)	4.35 (1949)	1.66 (1949)	6.6
February	1.06	.00 (1917)	3.65 (1915)	1.72 (1958)	6.8
March	1.55	([5]) (1917)	4.00 [6] (1876)	1.80 (1927)	6.7
April	2.57	.21 (1942)	10.78 (1944)	4.37 (1906)	.8
May	3.54	.21 (1934)	10.88 (1877)	4.30 (1918)	([5])
June	4.57	.31 (1933)	12.80 (1908)	4.18 (1908)	.0
July	2.99	.07 (1936)	10.62 (1915)	3.78 (1948)	.0
August	3.99	.16 (1882)	11.58 (1889)	7.00 (1889)	.0
September	2.67	.33 (1939)	9.77 (1906)	4.95 (1906)	.0
October	1.58	.00 [7] (1958)	6.87 (1928)	5.11 (1928)	.3
November	1.18	.00 [8] (1945)	5.65 (1909)	2.10 (1919)	2.6
December	.81	.00 [9] (1943)	3.06 (1909)	1.89 (1933)	5.4
Year	27.48				29.2

[1] 1931–1960.
[2] 1874–1962.
[3] 1889–1962.
[4] 1903–1962.
[5] Trace.
[6] Also in 1912.
[7] Also in 1945 and earlier.
[8] Also earlier.
[9] Also in 1912 and earlier.

that follows gives the percentage of months in a 73-year period (1889–1962) in which the precipitation was less than half of that given in the second column of table 8.

	Percentage of months		Percentage of months
January	42	July	23
February	26	August	22
March	33	September	31
April	27	October	24
May	21	November	43
June	15	December	50

The preceding list shows that July in 23 percent of the years in the 73-year period received less than half the 2.99 inches of precipitation listed in table 8 for July.

Droughts of varying severity occasionally occur. When these droughts are accompanied by excessively hot temperatures and drying winds, as they were in 1934 and 1936, the effects are disastrous, particularly to the corn crop. Excessive rains occasionally occur and cause severe flooding along the creek bottoms.

As in all the Great Plains area, occasionally there are severe storms. Damaging hailstorms also occur, but not so frequently as in western Nebraska. On August 5, 1958, a severe hailstorm severely damaged a strip several miles wide that extended from the vicinity of Wahoo to Ashland. Tornadoes occasionally occur, mostly late in spring and early in summer.

Agricultural Data

According to the 1959 Census of Agriculture, about 95 percent of Saunders County, or 461,104 acres, was in farms. Of this acreage, 83 percent, or 381,766 acres, was cropland; 8 percent, or 39,448 acres, was pasture that was not cropland or woodland; and 2 percent, or 9,134 acres, was woodland. The remaining acreage in farms was in house lots, roads, and the like. It amounted to 30,756 acres or 7 percent of the land in farms.

Tables 9, 10, and 11 list data relating to the agriculture of the county.

TABLE 9.—*Land in farms, number of farms, and average size of farms, in Saunders County in stated years*

	1930	1940	1950	1959
All land in farms ____ acres	462, 326	463, 111	455, 180	461, 104
Number of farms __ number	2, 699	2, 668	2, 390	2, 062
Average size of farms _ acres	171. 3	173. 6	190. 4	223. 6

TABLE 10.—*Acreage of principal crops in stated years*

Crop	1929	1939	1949	1959
	Acres	*Acres*	*Acres*	*Acres*
Corn	186, 315	159, 784	200, 914	187, 307
Small grains harvested or combined:				
Oats	--------	17, 808	61, 074	29, 103
Wheat	55, 973	64, 910	35, 219	38, 979
Rye	--------	1, 797	188	478
Barley	--------	8, 111	204	2, 216
All hay	38, 219	26, 373	33, 433	36, 301
Alfalfa hay	--------	7, 934	18, 258	27, 762
Potatoes	--------	456	61	13
Soybeans	--------	--------	3, 126	26, 000
Sorghums	473	16, 077	186	14, 699

TABLE 11.—*Number of livestock on farms in stated years*

Livestock	1930	1940	1950	1959
Cattle and calves	38, 414	[1] 42, 689	34, 194	49, 203
Horses and mules	14, 891	[1] 9, 939	3, 235	650
Sheep and lambs	3, 832	[2] 6, 213	1, 811	11, 833
Hogs and pigs	[3] 67, 796	[3] 25, 224	33, 641	48, 453

[1] Over 3 months.
[2] Over 6 months.
[3] Over 4 months.

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Glossary

Acid soil. Generally, a soil that is acid throughout most or all of the parts that plant roots penetrate. Commonly, only the plow layer or some other specific layer or horizon is designated acid. Practically, an acid soil is one that has a pH value less than 6.6; precisely, a soil with a pH value less than 7.0. A soil containing a preponderance of hydrogen over hydroxyl ions.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well-aerated soil is similar to that in the atmosphere, but that in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkaline soil has such a high degree of alkalinity that the growth of most crop plants is hindered. It has a pH value of at least 8.5 or a percentage of exchangeable sodium of at least 15 percent, or both. The term is also applied by some to those uncommon soils that contain sodium carbonate or other highly alkaline salts. In former years this term was also applied loosely to both alkali and saline soils.

Alkaline soil. Generally, a soil that is alkaline throughout most or all parts occupied by plant roots. The term is commonly applied to a specific layer, or horizon, of a soil. Precisely, any soil horizon having a pH value greater than 7.0; practically, a soil having a pH greater than 7.3.

Alluvium. Sand, mud, and other sediments deposited on land by streams.

Buried soil. A developed soil, once exposed but now overlain by more recently formed soil.

Calcareous soil. A soil alkaline in reaction because of the presence of calcium carbonate. A soil containing enough calcium carbonate to effervesce (fizz) when treated with dilute hydrocholoric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Claypan. A compact, slowly permeable soil horizon rich in clay and separated more or less abruptly from the overlying soil. Claypans are commonly hard when dry and plastic or stiff when wet.

Colloid, soil. Colloid refers to organic or inorganic matter having very small particle size and a correspondingly large surface area per unit of mass. Most colloidal particles are too small to be seen with the ordinary compound microscope. Soil colloids do not go into true solution as sugar or salt does, but they may be dispersed into a relatively stable suspension and thus be carried in moving water.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Color. A soil characteristic that indicates degree of drainage, content of organic matter, and other factors important in soil formation or in growth of crops. The color of soil may be indicated by words (yellowish brown) or by a Munsell notation (10YR 5/4). See Munsell notation.

Complex, soil. A mapping unit consisting of different kinds of soils that occur in such small individual areas or in such an intricate pattern that they cannot be shown separately on a publishable soil map.

Concretions. Hard grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds that cement the soil grains together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors, such as light, moisture, temperature, and the physical condition (or tilth) of the soil, are favorable.

Green-manure crop. Any crop grown and plowed under, at an early stage of maturity or soon after maturity, for the purpose of improving the soil.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major soil horizons:

A horizon. The mineral horizon at the surface. It contains organic matter, has been leached of soluble minerals and clay, or shows the effects of both.

B horizon. The horizon in which clay minerals or other material has accumulated, or that has developed a characteristic blocky or prismatic structure, or that shows the characteristics of both processes.

C horizon. The unconsolidated material immediately under the true soil. In chemical, physical, and mineral composition it is presumed to be similar to the material from which at least part of the overlying solum has developed.

D horizon. Any layer, or stratum, underlying the C horizon, or the B horizon if no C horizon is present. If this stratum is rock that presumably was the source of material in the C horizon, it is designated Dr.

Hue. One of the three variables of color. The dominant spectral (rainbow) color; it is related to the dominant wavelength of light.

Internal drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

Leaching, soil. The removal of soluble materials from soils or other material by percolating water.

Lime. Chemically, lime is calcium oxide (CaO), but its meaning has been extended to include all limestone-derived materials applied to neutralize acid soils. Agricultural lime can be obtained as ground limestone, hydrated lime, or burned lime, with or without magnesium minerals. Basic slag, oystershells, and marl also contain calcium.

Loam. The textural class name for soil having a moderate amount of sand, silt, and clay. Loams contain 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. As used in the United States, the term refers only to the relative amounts of sand, silt, and clay; loams may or may not be mellow.

Loess. Geological deposit of relatively uniform fine material that is mostly silt and presumably was transported by wind. Many kinds of soil in the United States have developed from loess blown out of alluvial valleys and from other deposits during periods of aridity.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *Fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, value of 6, and a chroma of 4.

Natural drainage. Moisture conditions that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have low water-holding capacity.

Somewhat excessively drained soils are very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Imperfectly drained or somewhat poorly drained soils are wet for significant periods but not all the time, and in podzolic soils mottles are common below 6 to 16 inches in the lower A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Nutrients, plant. Any element that is taken in by a plant, is essential to its growth, and is used by the plant in producing food and tissue. Important plant nutrients obtained from the soil are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps others. Those obtained largely from the air and water are carbon, hydrogen, and oxygen.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *Very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Phase, soil. A subdivision of a soil type, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects management.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material. See Horizon, soil.

Reaction, soil. The degree of acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. In words, the degree of acidity or alkalinity is expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Runoff. The amount of water removed by flow over the surface of the soil and rapidity of this flow. The amount and rapidity of runoff are affected by factors such as texture, structure, and porosity of the surface soil; the vegetative covering; the prevailing climate; and the slope. Relative degree of runoff is expressed in six classes as follows: *Very rapid, rapid, medium, slow, very slow,* and *ponded.*

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; or contains harmful salts and has a highly alkaline reaction; or contains harmful salts and exchangeable sodium and is strongly alkaline in reaction. In the profile the location of the salts, exchangeable sodium, and alkaline reaction is such that the growth of most plants is less than normal.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 millimeter to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface soil, are similar in differentiating characteristics and in arrangement of the profile.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soils of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. (1) The natural medium for the growth of land plants. (2) A dynamic natural body on the surface of the earth in which plants grow, composed of mineral and organic materials and living forms. (3) The collection of natural bodies occupying parts of the earth's surface that support plants and that have properties due to the integrated effect of climate and living matter acting upon parent material, as conditioned by relief, over periods of time. A soil is an individual three-dimensional body on the surface of the earth unlike the adjoining bodies.

Soil association. A group of soils geographically associated in a characteristic repeating pattern.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular.* Structureless soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subirrigation. Water applied in open ditches or tile lines until the water table is raised close enough to the soil surface so that crops can take in the water they need.

Subsoil. In many soils, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer beneath the solum, or true soil; the C or D horizon.

Surface layer. A term used in nontechnical soil descriptions for one or more upper layers of soil; includes the A horizon and, in some areas, part of the B horizon; has no depth limit.

Surface soil. Soil ordinarily moved in tillage, or its equivalent in uncultivated soil; about 5 to 8 inches thick.

Terrace. An embankment or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so that they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. Stream terraces are frequently called *second bottoms,* as contrasted to *flood plains,* and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. (See also Clay, Sand, and Silt.) The basic textural classes, in order of increasing proportions of fine particles are as follows: *Sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "*coarse,*" "*fine,*" or "*very fine.*"

Till. Unstratified glacial drift consisting of clay, sand, gravel, and boulders intermingled.

Tilth, soil. The physical condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Type, soil. A subdivision of the soil series that is made on the basis of differences in the texture of the surface layer.

Water-holding capacity. The capacity (or ability) of soil to hold water. The moisture-holding capacity of sandy soils is usually low, and that of clay soils is high. This property is often expressed in inches of water per foot depth of soil.

U.S. GOVERNMENT PRINTING OFFICE:1965

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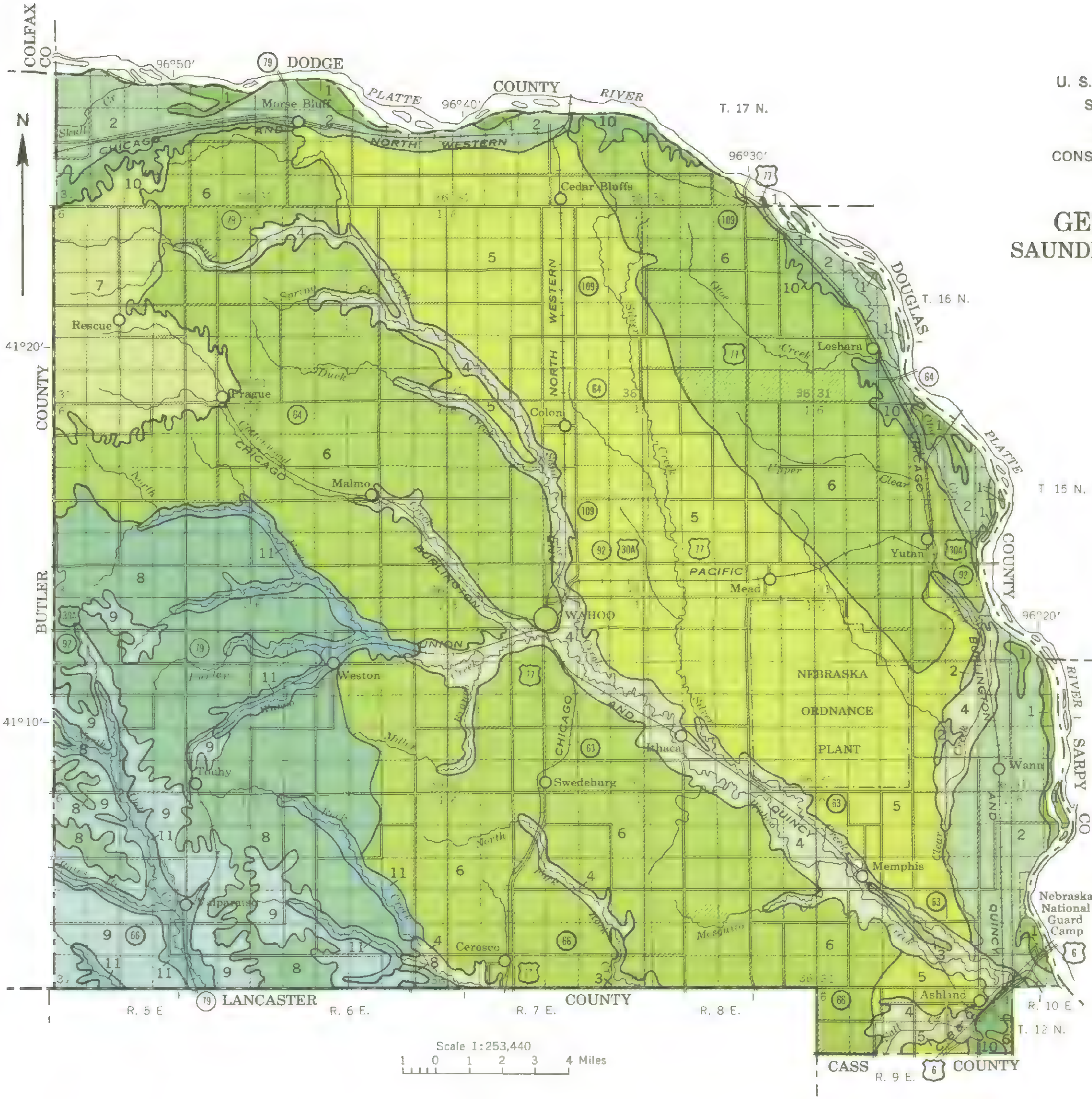
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UNIVERSITY OF NEBRASKA
CONSERVATION AND SURVEY DIVISION

GENERAL SOIL MAP
SAUNDERS COUNTY, NEBRASKA



SOIL ASSOCIATIONS

1 Sarpy-Barney association: Well-drained to poorly drained soils in sandy alluvium on bottom lands

2 Leshara-Wann association. Imperfectly drained, silty and sandy soils in alluvium on bottom lands

3 Lamoure-Rauville association: Imperfectly drained and poorly drained, moderately clayey soils in alluvium on bottom lands

4 Colo-Lamoure association: Imperfectly drained, moderately clayey soils in alluvium on nearly level bottom lands

5 Sharpsburg-Fillmore association: Deep, dark, moderately clayey and clayey, nearly level soils

6 Sharpsburg association: Deep, dark, well-drained, moderately clayey soils on uplands

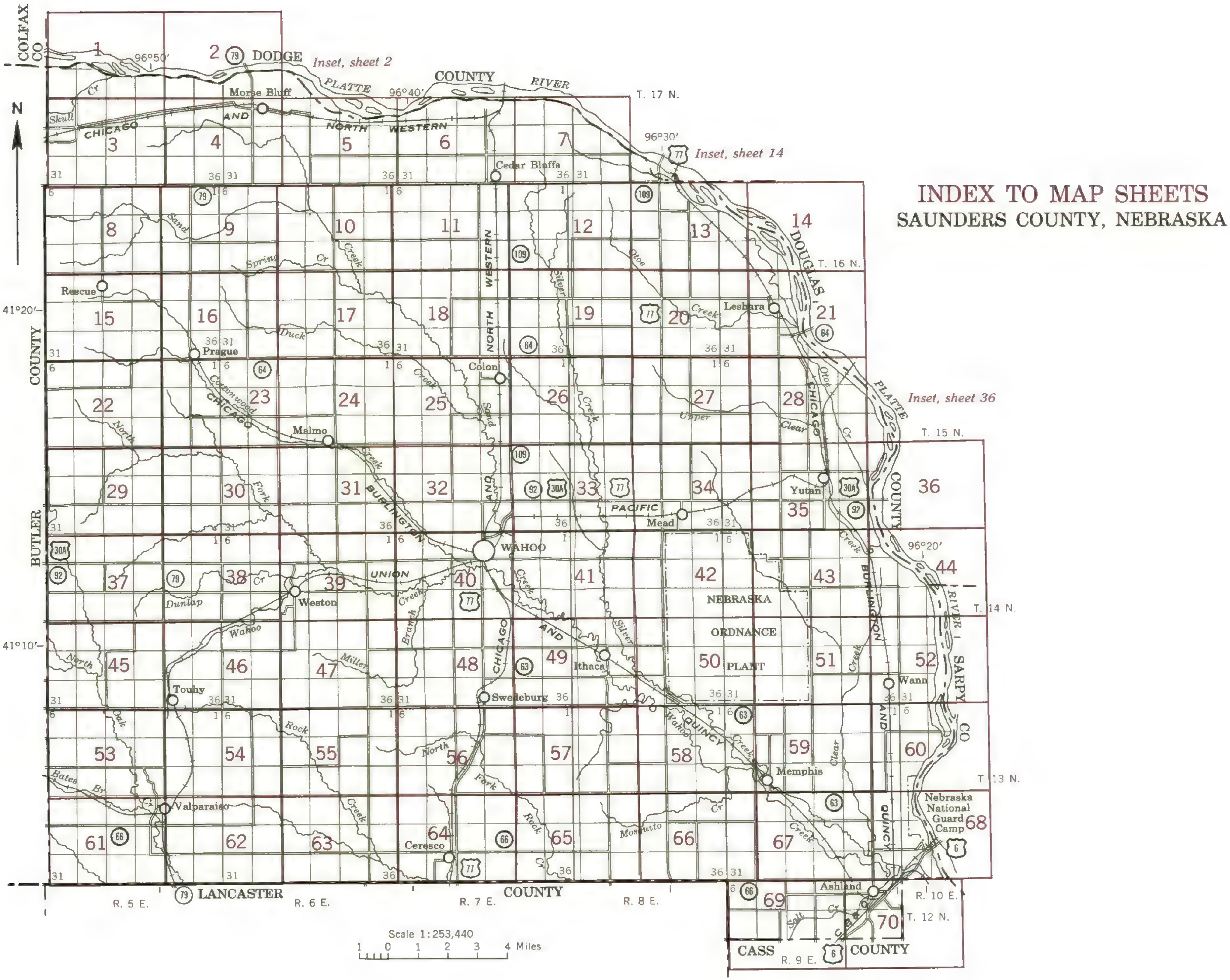
7 Monona-Sharpsburg association: Deep, dark, well-drained, silty and moderately clayey soils on uplands

8 Sharpsburg-Burchard association: Deep, dark, well-drained, moderately clayey soils on uplands

9 Burchard-Shelby association: Deep, dark, well-drained, moderately clayey and clayey soils on uplands

10 Monona association: Deep, silty soils on steep uplands

11 Muir-Hobbs association: Deep, silty to clayey soils on low terraces and on bottom lands that are flooded occasionally



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R. 8 E.
R. 9 E.
R. 10 E.
96°50′
96°40′
96°30′
96°20′
41°20′
41°10′
Scale 1:253,440
1 0 1 2 3 4 Miles

SAUNDERS COUNTY, NEBRASKA

SOIL LEGEND

Each soil symbol consists of letters or of letters and numbers; for example Lb, 2Lb, MnC, MnC3. The last capital letter shows the slope if slope forms part of the soil name. A final number, 2 or 3, shows that the soil is eroded or severely eroded.

SYMBOL	NAME
AdC2	Adair clay loam, 6 to 9 percent slopes, eroded
AdD2	Adair clay loam, 9 to 12 percent slopes, eroded
APD3	Adair and Pawnee soils, 6 to 12 percent slopes, severely eroded
B2	Barney soils
BSE	Burchard and Shelby clay loams, 12 to 17 percent slopes
BSE2	Burchard and Shelby clay loams, 12 to 17 percent slopes, eroded
BSE3	Burchard and Shelby clay loams, 12 to 17 percent slopes, severely eroded
Bt	Butler silty clay loam
Cs	Cass fine sandy loam, moderately deep
3Cs	Cass fine sandy loam, deep
Ct	Colo silty clay loam
2Ct	Colo silty clay loam, clayey substratum
Fi	Fillmore silty clay loam
2Fi	Fillmore silty clay loam, ponded
GeC2	Geary silty clay loam, 6 to 12 percent slopes, eroded
GeC3	Geary silty clay loam, 6 to 12 percent slopes, severely eroded
GL	Gullied land
Hz	Hobbs soils
JfB	Judson fine sandy loam, 2 to 6 percent slopes
JtB	Judson silty clay loam, 2 to 6 percent slopes
Lb	Lamoure silty clay loam
2Lb	Lamoure silty clay loam, alkali
Le	Leshara silt loam, deep
2Le	Leshara silt loam, alkali
3Le	Leshara silt loam, moderately deep
Lu	Luton clay
2Lu	Luton soils, saline
MhC2	Monona silt loam, sand substratum, 6 to 12 percent slopes, eroded
MhE2	Monona silt loam, sand substratum, 12 to 30 percent slopes, eroded
Mk	Muck
ML	Made land
MnC	Monona silt loam, 6 to 12 percent slopes
MnC2	Monona silt loam, 6 to 12 percent slopes, eroded
MnD2	Malcolm silt loam, 6 to 12 percent slopes, eroded
MnE2	Monona silt loam, 12 to 17 percent slopes, eroded
MnE	Monona silt loam, 12 to 17 percent slopes
MnF	Monona silt loam, 17 to 30 percent slopes
MrC2	Morrill clay loam, 6 to 12 percent slopes, eroded
MrC3	Morrill clay loam, 6 to 12 percent slopes, severely eroded
Mt	Muir silty clay loam
OrC2	Ortello complex, 6 to 12 percent slopes, eroded
OrE2	Ortello complex, 12 to 17 percent slopes, eroded
Pt	Platte loam
PwC2	Pawnee clay loam, 6 to 9 percent slopes, eroded
PwD2	Pawnee clay loam, 9 to 12 percent slopes, eroded
Ra	Rauville soils
Rw	Riverwash
Sa	Sarpy fine sand
2Sa	Sarpy fine sand, hummocky
SBD	Shelby and Burchard clay loams, 6 to 12 percent slopes
SBD2	Shelby and Burchard clay loams, 6 to 12 percent slopes, eroded
SBD3	Shelby and Burchard clay loams, 6 to 12 percent slopes, severely eroded
Sg	Sarpy loamy fine sand
2Sg	Sarpy loamy fine sand, imperfectly drained
4Sg	Sarpy loamy fine sand, loamy substratum
ShA	Sharpsburg silty clay loam, 0 to 2 percent slopes
ShB	Sharpsburg silty clay loam, 2 to 4 percent slopes
ShC2	Sharpsburg silty clay loam, 4 to 6 percent slopes, eroded
ShD2	Sharpsburg silty clay loam, 6 to 12 percent slopes, eroded
ShD3	Sharpsburg silty clay loam, 6 to 12 percent slopes, severely eroded
ShE2	Sharpsburg silty clay loam, 12 to 17 percent slopes, eroded
ShE3	Sharpsburg silty clay loam, 12 to 17 percent slopes, severely eroded
StE	Steinauer clay loam, 12 to 30 percent slopes
SWB	Sharpsburg and Wymore silty clay loams, 2 to 4 percent slopes
SWC2	Sharpsburg and Wymore silty clay loams, 4 to 6 percent slopes, eroded
SWD2	Sharpsburg and Wymore silty clay loams, 6 to 12 percent slopes, eroded
SWD3	Sharpsburg and Wymore silty clay loams, 6 to 12 percent slopes, severely eroded
SWE2	Sharpsburg and Wymore silty clay loams, 12 to 17 percent slopes, eroded
SWE3	Sharpsburg and Wymore silty clay loams, 12 to 17 percent slopes, severely eroded
Sx	Mixed alluvial land
Sy	Alluvial land
Vo	Volin silt loam
Wb	Wann fine sandy loam, moderately deep
2Wb	Wann fine sandy loam, alkali
3Wb	Wann fine sandy loam, deep

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads

- Dual
- Good motor
- Poor motor
- Trail

Highway markers

- National Interstate
- U. S.
- State

Railroads

- Single track
- Multiple track
- Abandoned

Bridges and crossings

- Road
- Trail, foot
- Railroad
- Ferries
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings

- School
- Church
- Station

Mines and Quarries

Mine dump

Pits, gravel or other

Power lines

Pipe lines

Cemeteries

Dams

Levees

Tanks

Airway beacon

Windmills

BOUNDARIES

- National or state
- County
- Township, U. S.
- Section line, corner
- Reservation
- Land grant

DRAINAGE

Streams

- Perennial
- Intermittent, unclass.
  - Crossable with tillage implements
  - Not crossable with tillage implements

Canals and ditches — CANAL, DITCH

Lakes and ponds

- Perennial
- Intermittent

Wells — flowing

Springs

Marsh

Wet spot

Falls

RELIEF

Escarpments

- Bedrock
- Other

Prominent peaks

Depressions — Large, Small

SOIL SURVEY DATA

- Soil boundary and symbol — Dx
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo, scabby, or saline spot — S
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gullies
- Short steep slope
- Dugout

Soil map constructed 1963 by Cartographic Division, Soil Conservation Service, USDA, from 1955 aerial photographs. Controlled mosaic based on Nebraska plane coordinate system, south zone, Lambert conformal conic projection. 1927 North American datum.

GUIDE TO MAPPING UNITS AND CAPABILITY UNITS

[See table 1, p. 7 , for approximate acreage and proportionate extent of each soil; see table 2, p.36 , for estimated yields of principal crops on each soil; see table 3, p. 40 , for windbreak suitability groups; and see p.64 to p.74 for profile descriptions representative of each soil series]

Map symbol	Mapping unit	Page	Capability unit	
			Symbol	Page
AdC2	Adair clay loam, 6 to 9 percent slopes, eroded	8	IIIe-2	29
AdD2	Adair clay loam, 9 to 12 percent slopes, eroded	8	IVe-2	32
APD3	Adair and Pawnee soils, 6 to 12 percent slopes, severely eroded	8	VIe-2	33
B2	Barney soils	8	Vw-6	33
BSE	Burchard and Shelby clay loams, 12 to 17 percent slopes	9	IVe-1	32
BSE2	Burchard and Shelby clay loams, 12 to 17 percent slopes, eroded	9	IVe-1	32
BSE3	Burchard and Shelby clay loams, 12 to 17 percent slopes, severely eroded	9	VIe-8	34
Bt	Butler silty clay loam	9	IIs-2	28
Cs	Cass fine sandy loam, moderately deep	10	IIe-3	27
3Cs	Cass fine sandy loam, deep	10	IIe-3	27
Ct	Colo silty clay loam	10	IIw-3	27
2Ct	Colo silty clay loam, clayey substratum	10	IIw-4	28
Fi	Fillmore silty clay loam	11	IIIw-2	31
2Fi	Fillmore silty clay loam, ponded	11	IVw-2	33
GeC2	Geary silty clay loam, 6 to 12 percent slopes, eroded	11	IIIe-1	29
GeC3	Geary silty clay loam, 6 to 12 percent slopes, severely eroded	11	IVe-8	32
GL	Gullied land	11	VIIe-1	34
Hz	Hobbs soils	12	IIw-3	27
JfB	Judson fine sandy loam, 2 to 6 percent slopes	12	IIIe-3	30
JtB	Judson silty clay loam, 2 to 6 percent slopes	12	IIe-1	27
Lb	Lamoure silty clay loam	13	IIw-4	28
2Lb	Lamoure silty clay loam, alkali	13	IIIs-1	31
Le	Leshara silt loam, deep	13	IIw-4	28
2Le	Leshara silt loam, alkali	13	VIs-1	34
3Le	Leshara silt loam, moderately deep	13	IIw-4	28
Lu	Luton clay	13	IIIw-1	30
2Lu	Luton soils, saline	14	VIs-1	34
MhC2	Monona silt loam, sand substratum, 6 to 12 percent slopes, eroded	15	IVe-8	32
MhE2	Monona silt loam, sand substratum, 12 to 30 percent slopes, eroded	15	VIe-8	34
Mk	Muck	15	IIw-4	28
ML	Made land	14	VIIs-1	34
MnC	Monona silt loam, 6 to 12 percent slopes	15	IIIe-1	29
MnC2	Monona silt loam, 6 to 12 percent slopes, eroded	15	IIIe-8	30
MmD2	Malcolm silt loam, 6 to 12 percent slopes, eroded	14	IIIe-1	29
MnE	Monona silt loam, 12 to 17 percent slopes	15	IVe-1	32
MnE2	Monona silt loam, 12 to 17 percent slopes, eroded	15	IVe-8	32
MnF	Monona silt loam, 17 to 30 percent slopes	15	VIe-1	33
MrC2	Morrill clay loam, 6 to 12 percent slopes, eroded	15	IVe-1	32
MrC3	Morrill clay loam, 6 to 12 percent slopes, severely eroded	15	IVe-8	32
Mt	Muir silty clay loam	16	I-1	26
OrC2	Ortello complex, 6 to 12 percent slopes, eroded	16	IVe-3	32
OrE2	Ortello complex, 12 to 17 percent slopes, eroded	16	VIe-3	33
Pt	Platte loam	17	IVs-4	33
PwC2	Pawnee clay loam, 6 to 9 percent slopes, eroded	17	IIIe-2	29
PwD2	Pawnee clay loam, 9 to 12 percent slopes, eroded	17	IVe-2	32
Ra	Rauville soils	17	Vw-6	33
Rw	Riverwash	17	VIIIw-3	35
Sa	Sarpy fine sand	17	VIe-5	33
2Sa	Sarpy fine sand, hummocky	17	VIe-5	33
SBD	Shelby and Burchard clay loams, 6 to 12 percent slopes	20	IVe-1	32
SBD2	Shelby and Burchard clay loams, 6 to 12 percent slopes, eroded	20	IVe-1	32
SBD3	Shelby and Burchard clay loams, 6 to 12 percent slopes, severely eroded	20	IVe-8	32
Sg	Sarpy loamy fine sand	17	IIIe-5	30
2Sg	Sarpy loamy fine sand, imperfectly drained	18	IIIw-5	31
4Sg	Sarpy loamy fine sand, loamy substratum	17	IIIe-5	30
ShA	Sharpsburg silty clay loam, 0 to 2 percent slopes	18	I-1	26
ShB	Sharpsburg silty clay loam, 2 to 4 percent slopes	18	IIe-1	27
ShC2	Sharpsburg silty clay loam, 4 to 6 percent slopes, eroded	18	IIIe-1	29
ShD2	Sharpsburg silty clay loam, 6 to 12 percent slopes, eroded	18	IIIe-1	29
ShD3	Sharpsburg silty clay loam, 6 to 12 percent slopes, severely eroded	18	IIIe-8	30
ShE2	Sharpsburg silty clay loam, 12 to 17 percent slopes, eroded	18	IVe-1	32
ShE3	Sharpsburg silty clay loam, 12 to 17 percent slopes, severely eroded	19	IVe-8	32
StE	Steinauer clay loam, 12 to 30 percent slopes	20	VIe-1	33
SWB	Sharpsburg and Wymore silty clay loams, 2 to 4 percent slopes	19	IIe-1	27
SWC2	Sharpsburg and Wymore silty clay loams, 4 to 6 percent slopes, eroded	19	IIIe-1	29
SWD2	Sharpsburg and Wymore silty clay loams, 6 to 12 percent slopes, eroded	19	IIIe-1	29
SWD3	Sharpsburg and Wymore silty clay loams, 6 to 12 percent slopes, severely eroded	19	IIIe-8	30
SWE2	Sharpsburg and Wymore silty clay loams, 12 to 17 percent slopes, eroded	19	IVe-1	32
SWE3	Sharpsburg and Wymore silty clay loams, 12 to 17 percent slopes, severely eroded	19	IVe-8	32
Sx	Mixed alluvial land	14	VIw-5	34
Sy	Alluvial land	8	VIw-1	34
Vo	Volin silt loam	21	I-1	26
Wb	Wann fine sandy loam, moderately deep	21	IIIw-6	31
2Wb	Wann fine sandy loam, alkali	21	VIs-1	34
3Wb	Wann fine sandy loam, deep	21	IIw-6	28

727-524 O - 65 (Face p. 82)

1

(Joins sheet 3)

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½ 1 Mile Scale 1: 20 000 0 5000 Feet

2

N

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

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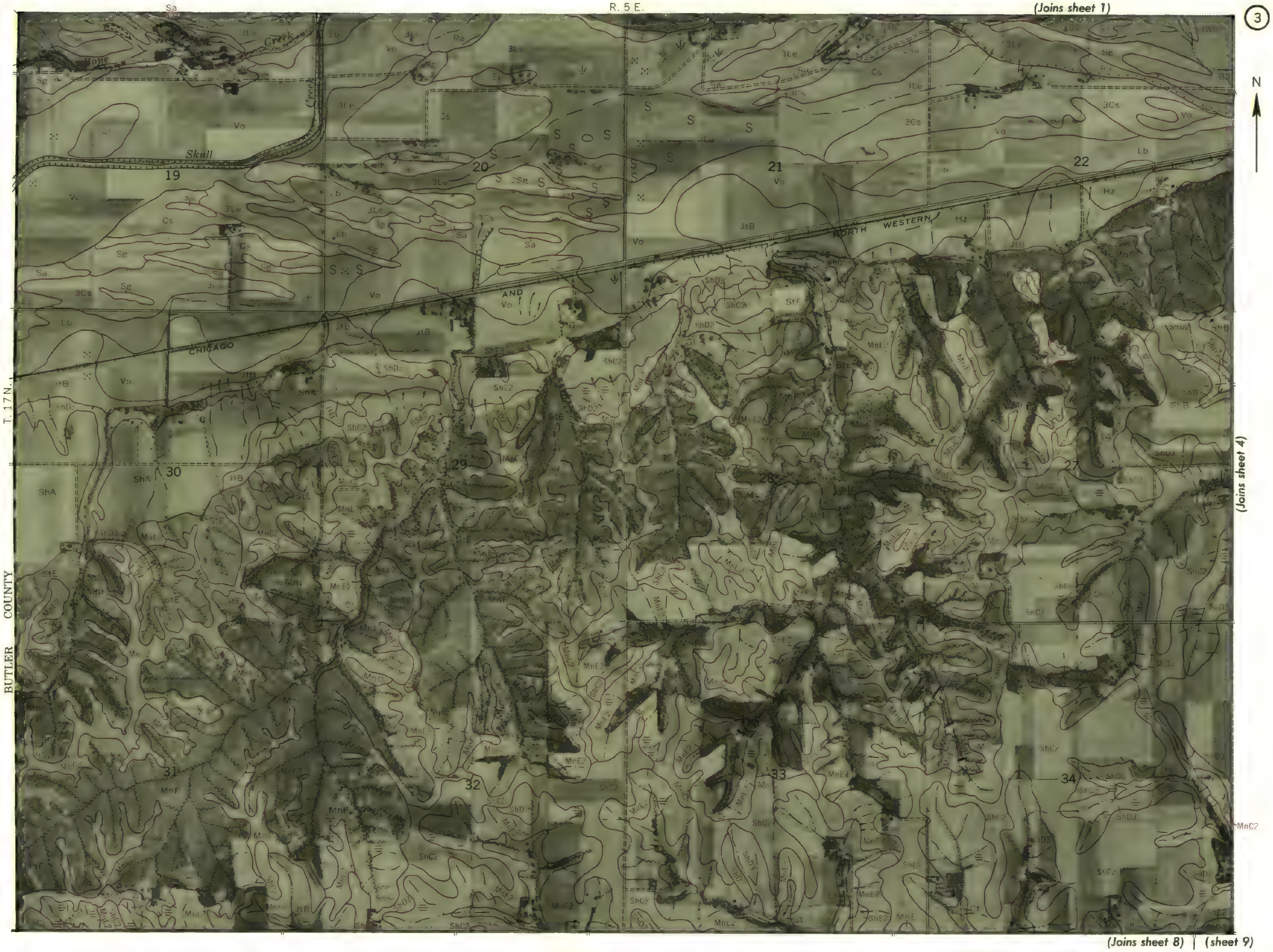
Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet


4
(Joins sheet 2)
R. 5 E. | R. 6 E.
N
(Joins sheet 3)
(Joins sheet 5)
T. 17 N.
Morse Bluff
19
20
23
24
25
26
29
30
31
32
35
36
(Joins sheet 9) | (Joins sheet 10)
0 ½ 1 Mile
Scale 1:20 000
0 5000 Feet

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(Joins inset, sheet 2)

R. 6 E.

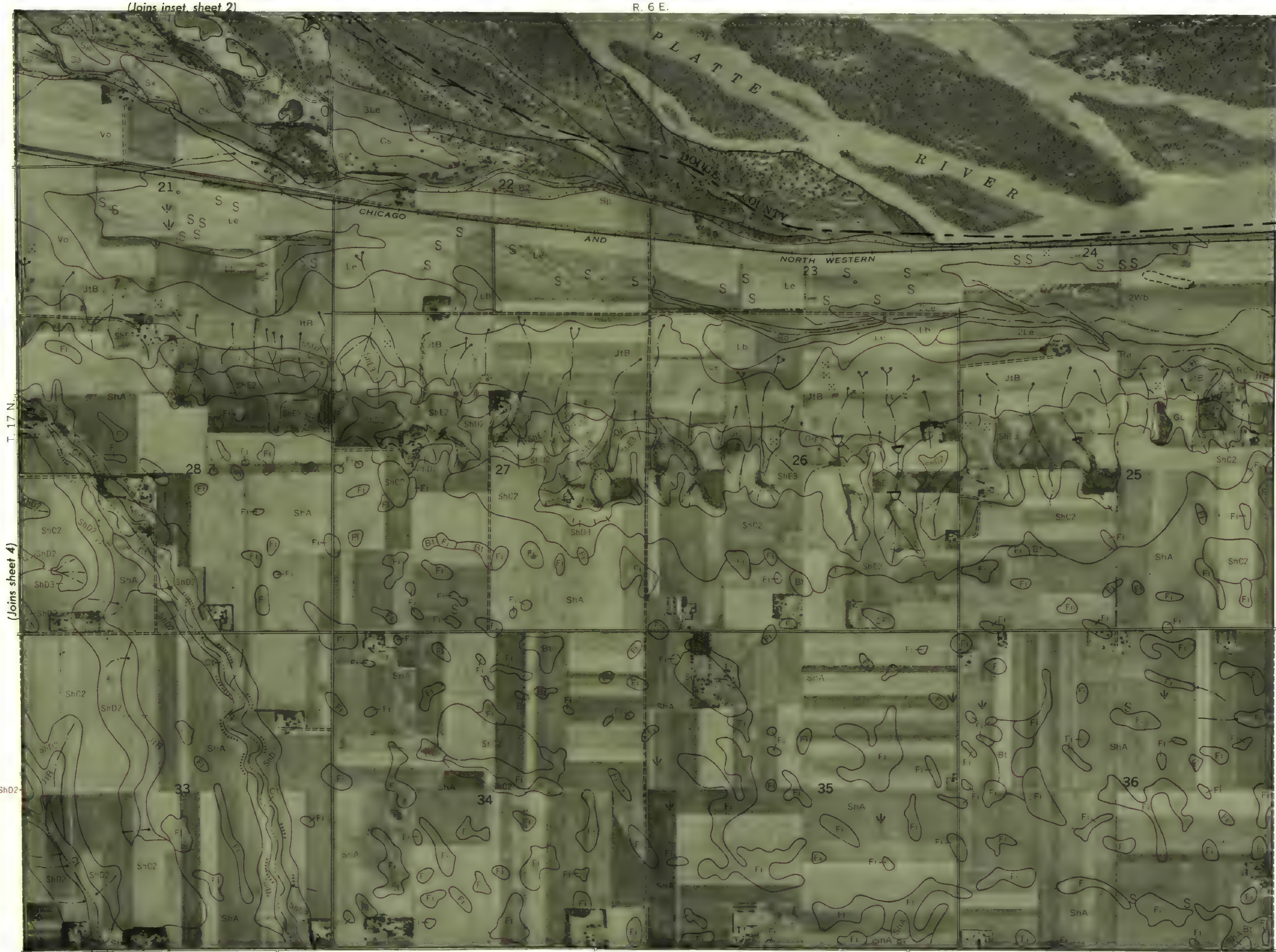
5

N

T. 17 N.

(Joins sheet 4)

(Joins sheet 6)



(Joins sheet 10) | (Joins sheet 11)

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SAUNDERS COUNTY, NEBRASKA — SHEET NUMBER 6

(6)

R. 7 E.

N

T. 17 N.

(Joins sheet 5)

(Joins sheet 7)

(Joins sheet 11) | (Joins sheet 12)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

SAUNDERS COUNTY, NEBRASKA — SHEET NUMBER 7

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Range, township, and section corners shown on this map are indefinite.

R. 7 E. | R. 8 E.

7

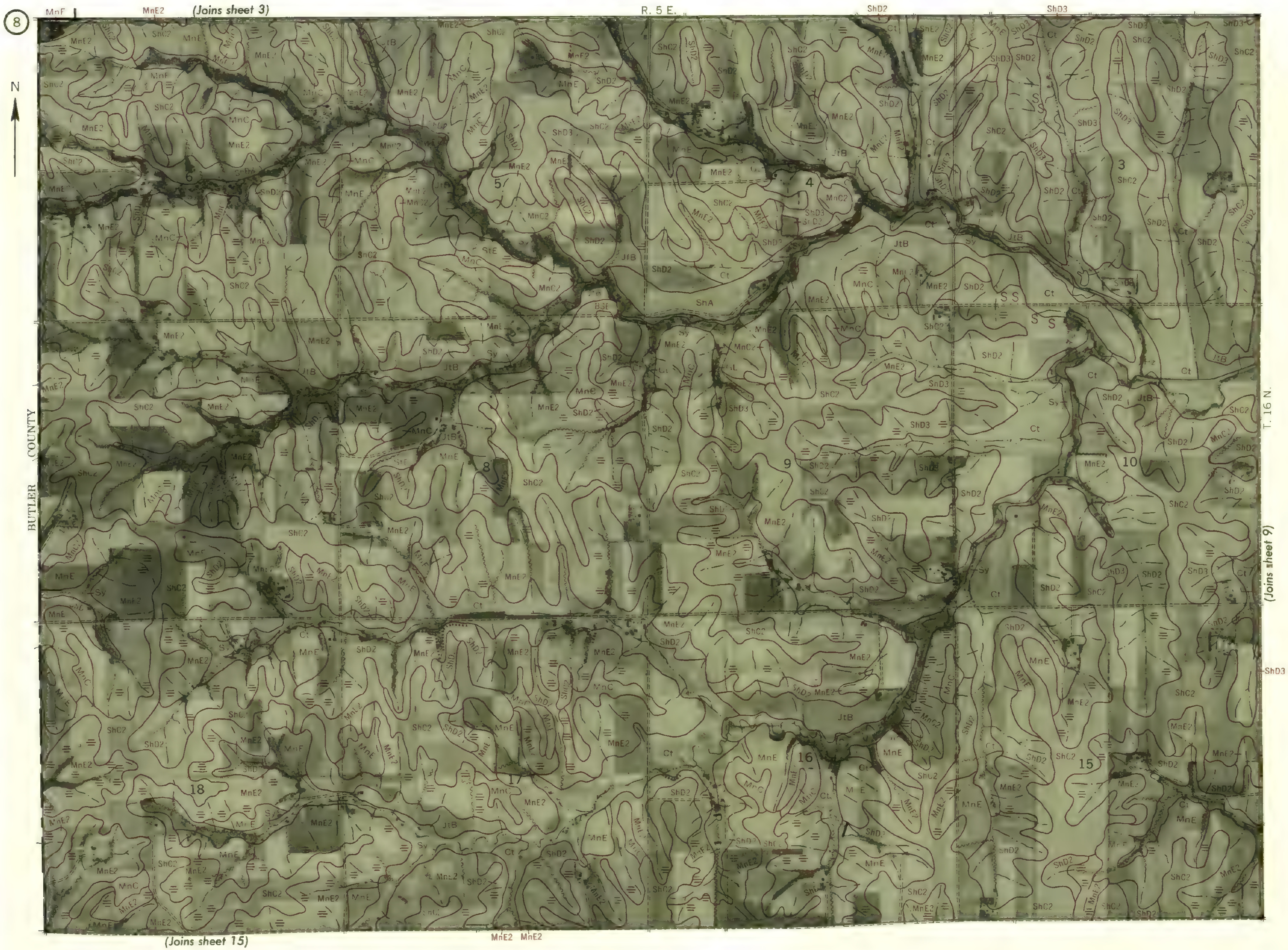
N

(Joins sheet 6)

(Joins inset, sheet 14)

(Joins sheet 12)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet



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0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

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10
(Sheet 4)
(Joins sheet 5)
R. 6 E.
N
(Joins sheet 9)
(Joins sheet 11)
T. 16 N.
(Joins sheet 17)
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

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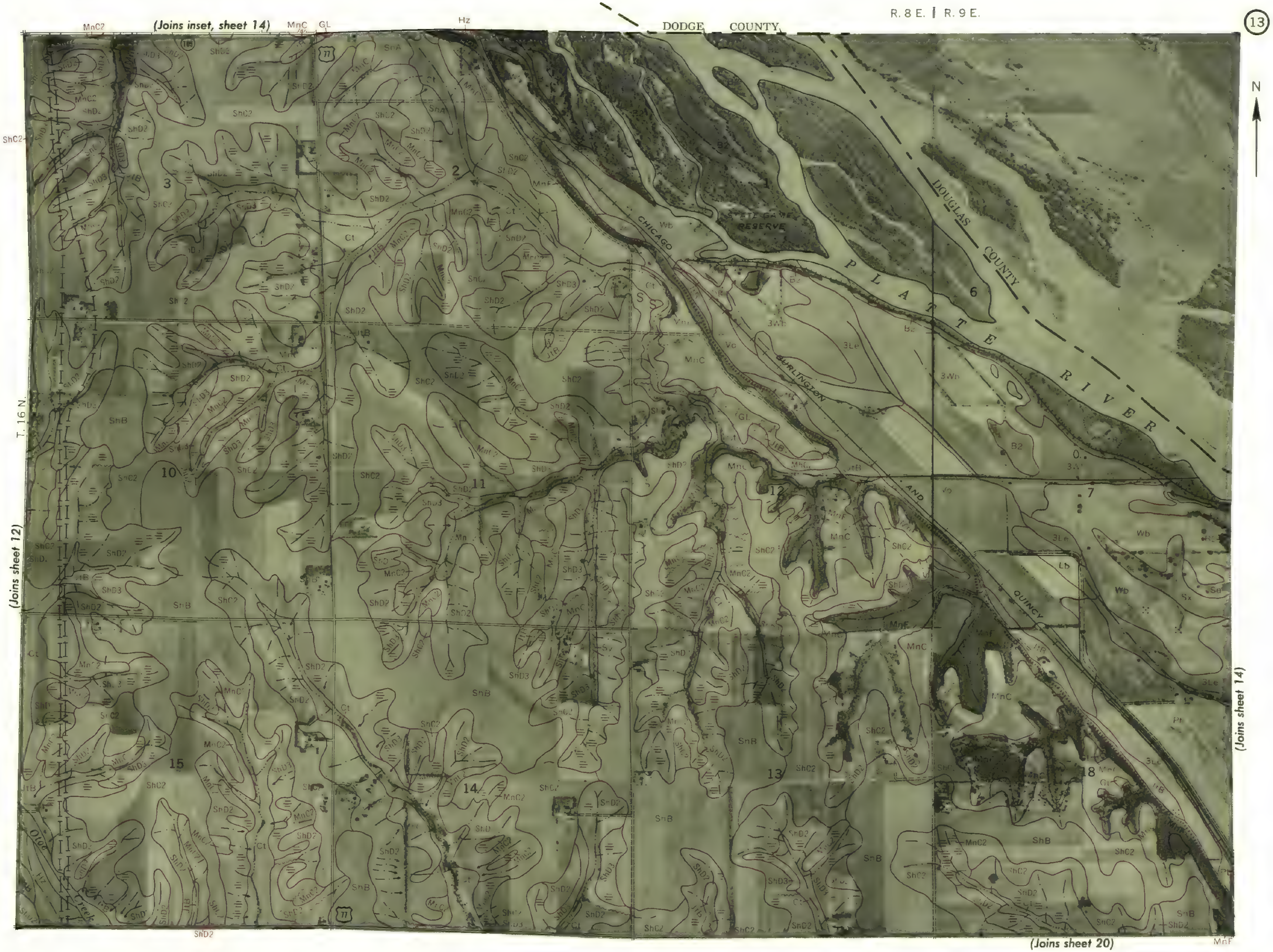
Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



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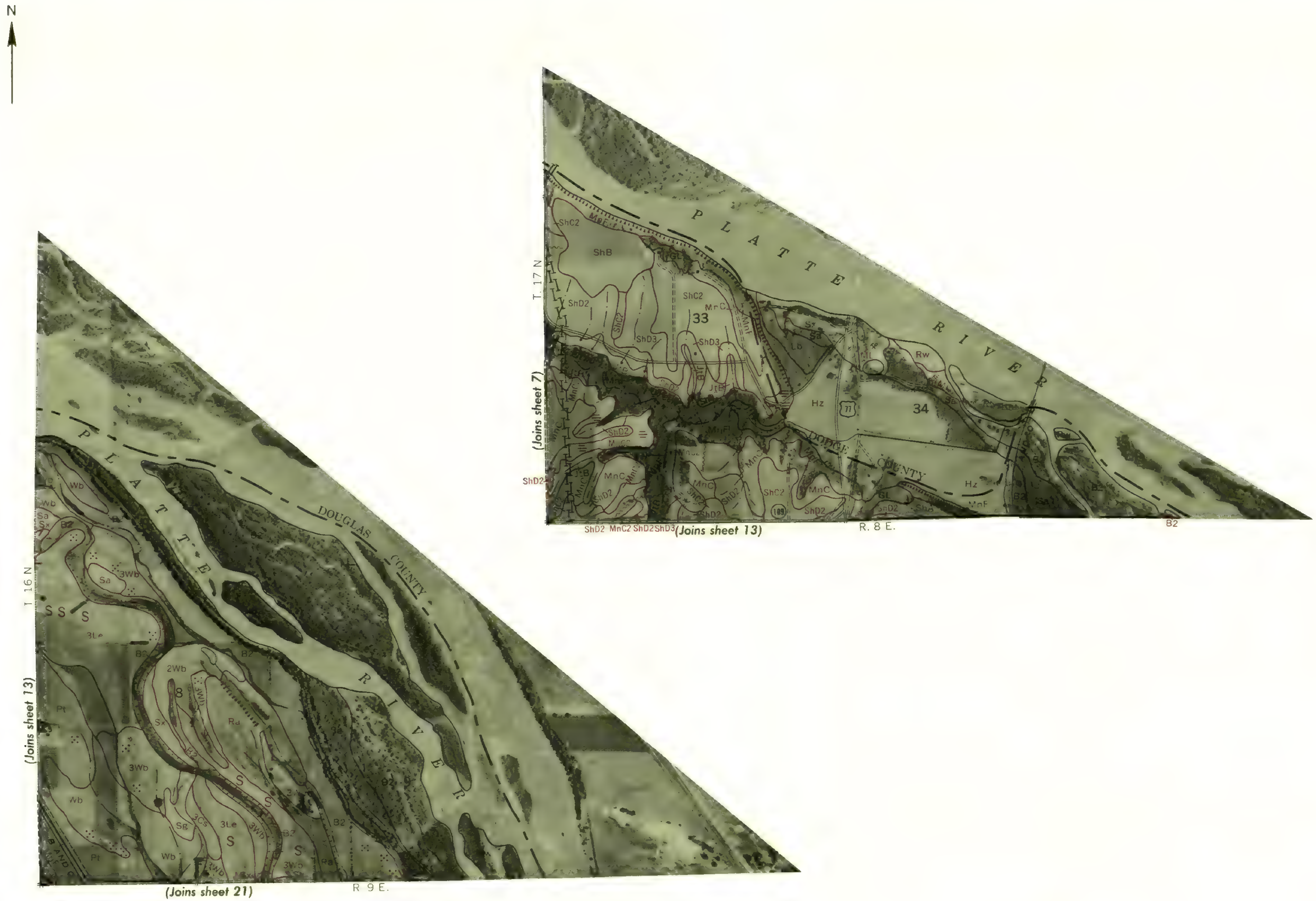
(14)



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0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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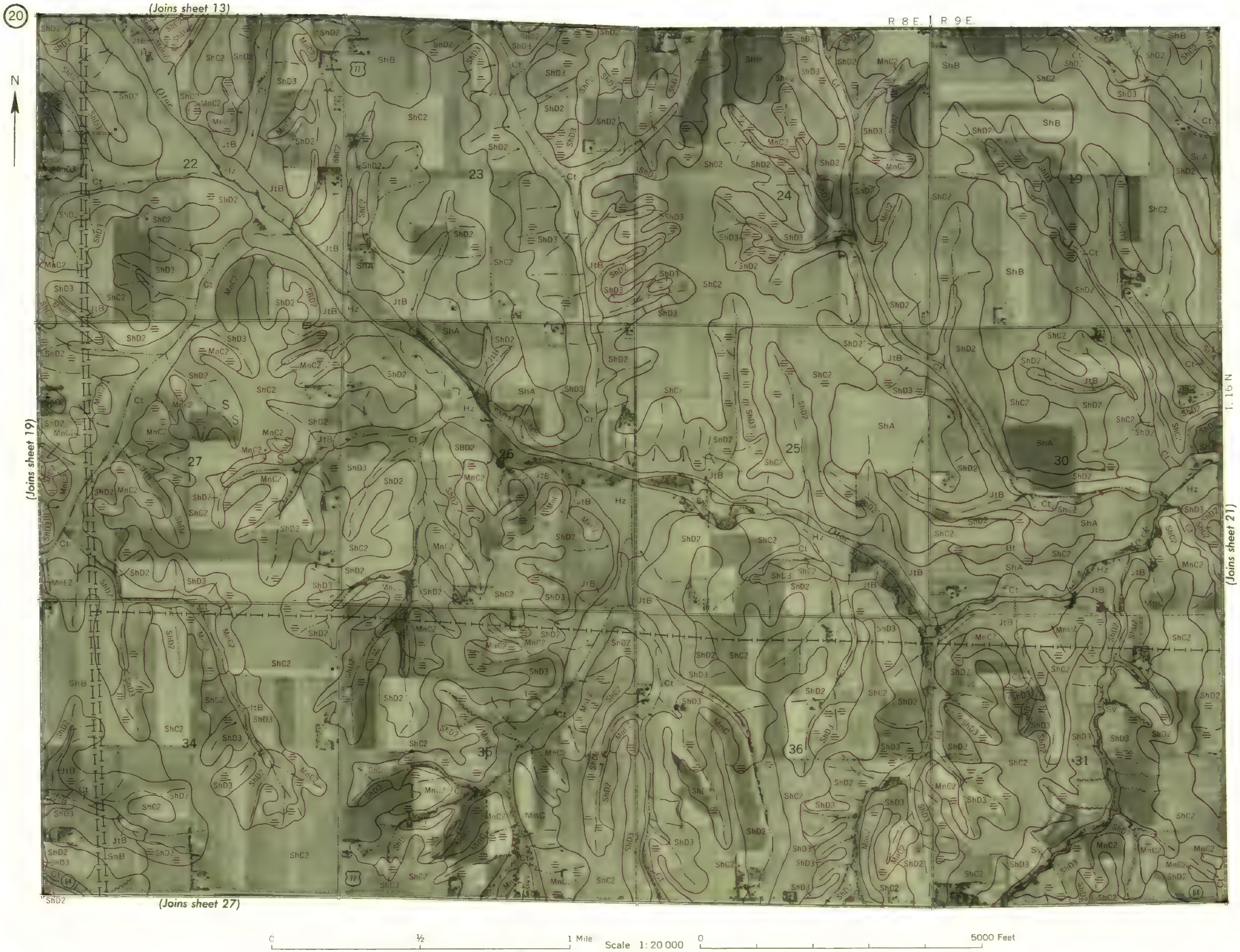
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

SAUNDERS COUNTY, NEBRASKA — SHEET NUMBER 20



21

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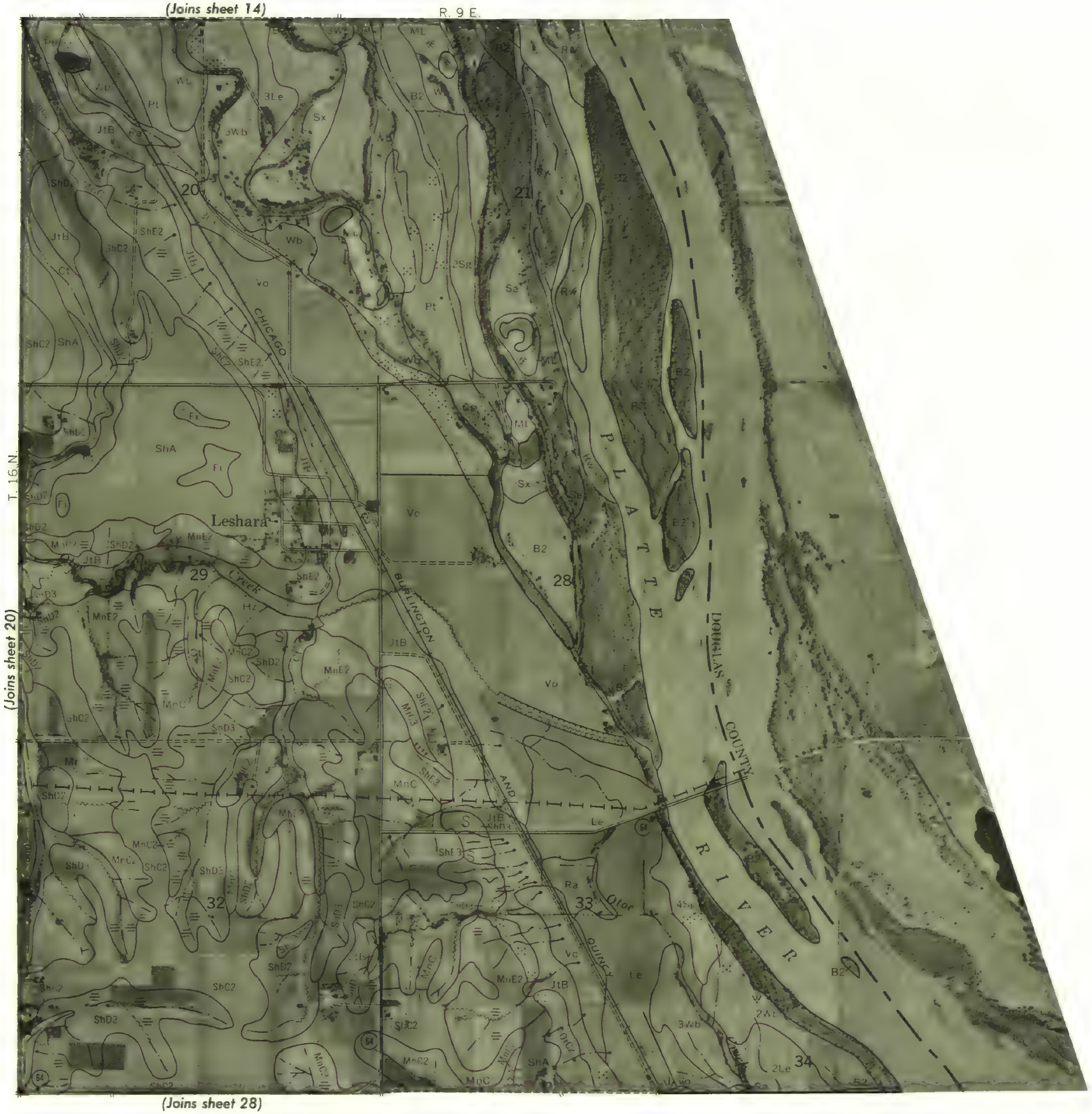

N

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet


22
(Joins sheet 15)
R. 5 E.
N
BUTLER COUNTY
T. 15 N.
(Joins sheet 23)
(Joins sheet 29)
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

SAUNDERS COUNTY, NEBRASKA — SHEET NUMBER 23

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

SAUNDERS COUNTY, NEBRASKA — SHEET NUMBER 24

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

Range, township, and section corners shown on this map are indefinite.


26
(Joins sheet 19)
R. 7 E. | R. 8 E.
N
(Joins sheet 25)
(Joins sheet 27)
T. 15 N.
(Joins sheet 33)
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

Range, township, and section corners shown on this map are indefinite.


28
(Joins sheet 21)
R. 9 E.
N
(Joins sheet 27)
(Joins inset, sheet 36)
T. 15 N.
(Joins sheet 35)
PLATTE RIVER
DOUGLAS COUNTY
CHICAGO BURLINGTON AND QUINCY
PACIFIC
Upper
Clear
Creek
Otoe
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.


30
(Joins sheet 23)
R. 5 E. | R. 6 E.
N
(Joins sheet 29)
(Joins sheet 31)
T. 15 N.
(Joins sheet 38)
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 25)

(Joins sheet 31)

(Joins sheet 33)

(Joins sheet 40)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

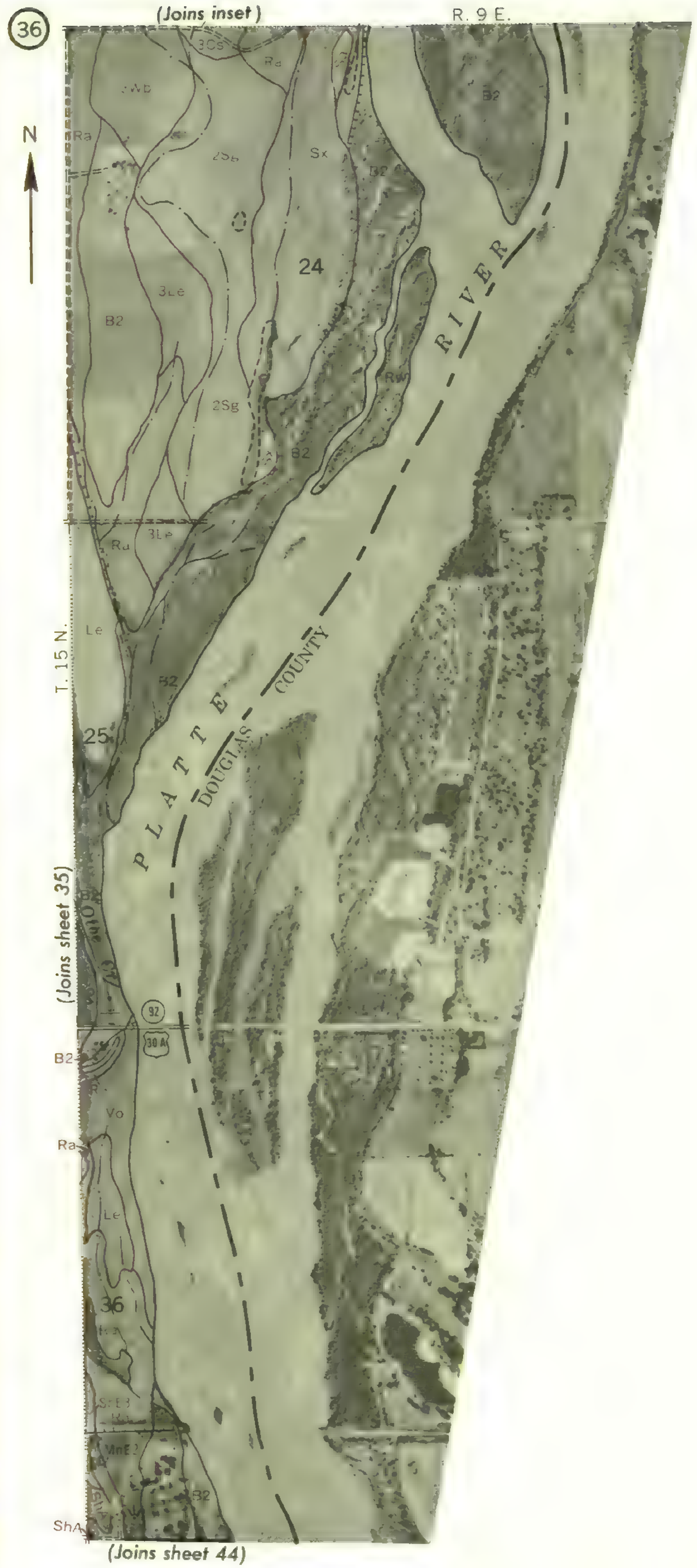
Range, township, and section corners shown on this map are indefinite.


34
(Joins sheet 27)
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 42)
N
R. 8 E.
R. 9 E.
T. 15 N.
22
23
24
19
27
26
25
30
34
35
36
31
Mead
UNION
PACIFIC
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture and the Conservation and Survey Division, University of Nebraska

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

Range, township, and section corners shown on this map are indefinite.

SAUNDERS COUNTY, NEBRASKA — SHEET NUMBER 38

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska

Range, township, and section corners shown on this map are indefinite.

42

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

Range, township, and section corners shown on this map are indefinite.


46
(Joins sheet 38)
R. 5 E. | R. 6 E.
N
(Joins sheet 45)
(Joins sheet 47)
T. 14 N.
(Joins sheet 54)
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet
23
24
19
20
26
25
30
29
35
36
31
32
Touhy

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

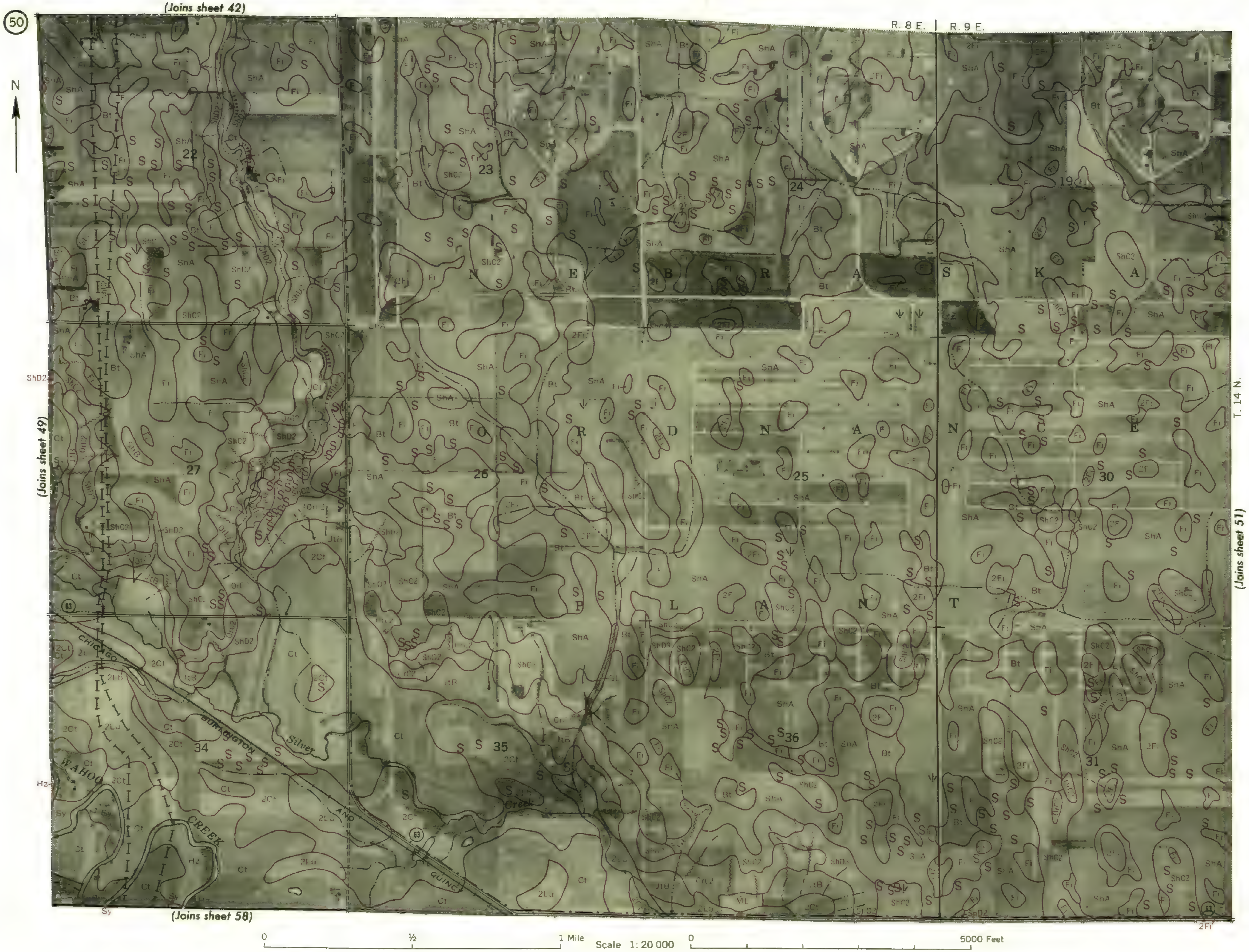
Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

Range, township, and section corners shown on this map are indefinite.


50
(Joins sheet 42)
(Joins sheet 49)
(Joins sheet 51)
(Joins sheet 58)
N
R. 8 E. | R. 9 E.
T. 14 N.
NEBRASKA
ORDNANCE
PLANT
Silver Creek
WAHOO CREEK
CHICAGO BURLINGTON AND QUINCY
22
23
24
19
27
26
25
30
34
35
36
31
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

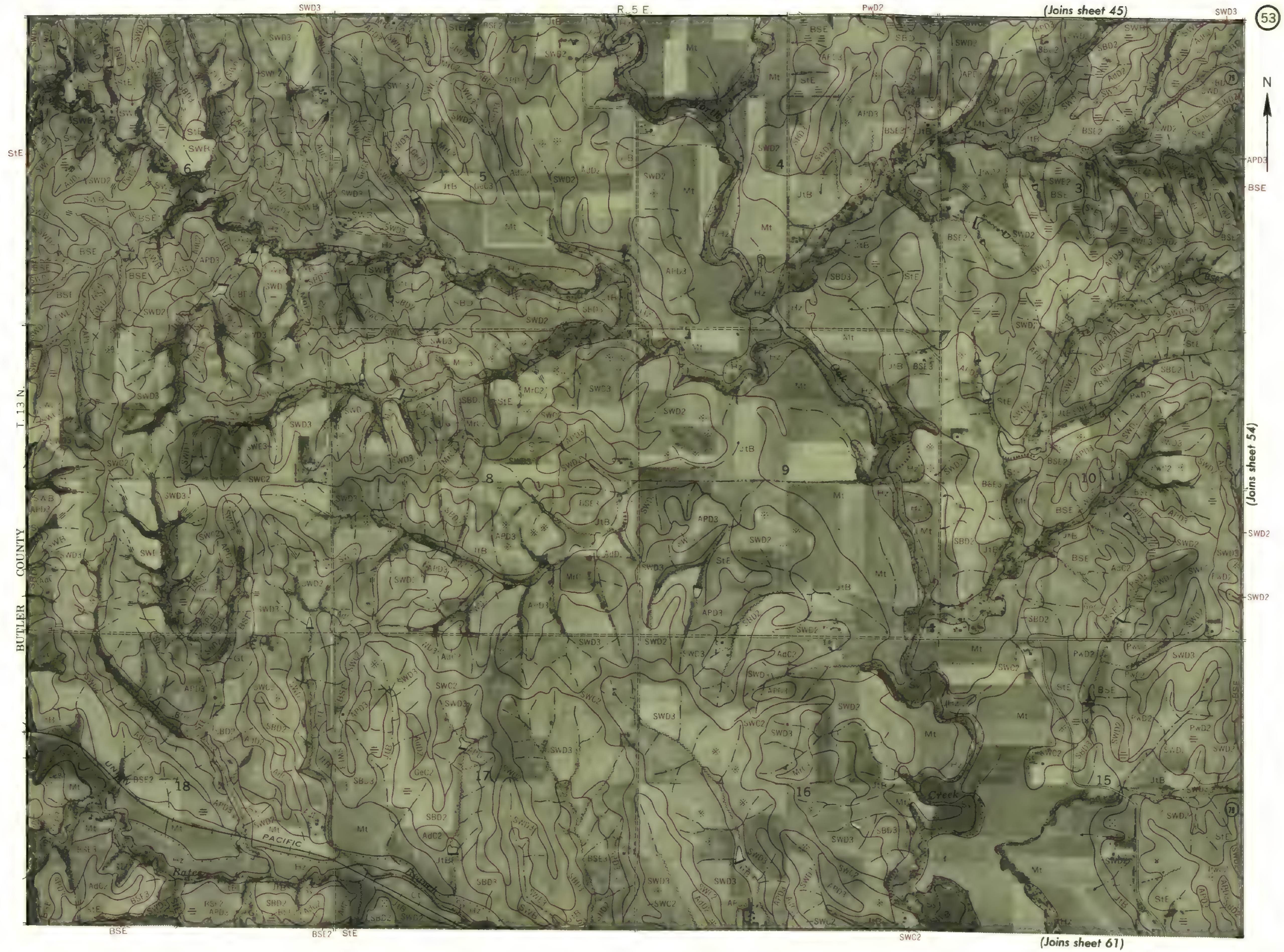
Range, township, and section corners shown on this map are indefinite.


52
(Joins sheet 44)
R. 9 E. | R. 10 E.
N
T. 14 N.
(Joins sheet 51)
(Joins sheet 60)
Clear Creek
CHICAGO BURLINGTON AND QUINCY
PLATTE RIVER
SARPY COUNTY
Wann
24
19
20
25
30
29
36
31
32
0 ½ 1 Mile
Scale 1:20 000
0 5000 Feet

SAUNDERS COUNTY, NEBRASKA — SHEET NUMBER 53

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet


54
(Joins sheet 46)
R. 5 E. R. 6 E.
N
(Joins sheet 53)
(Joins sheet 55)
T. 13 N.
(Joins sheet 62)
UNION PACIFIC
0 ½ 1 Mile
Scale 1:20 000
0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

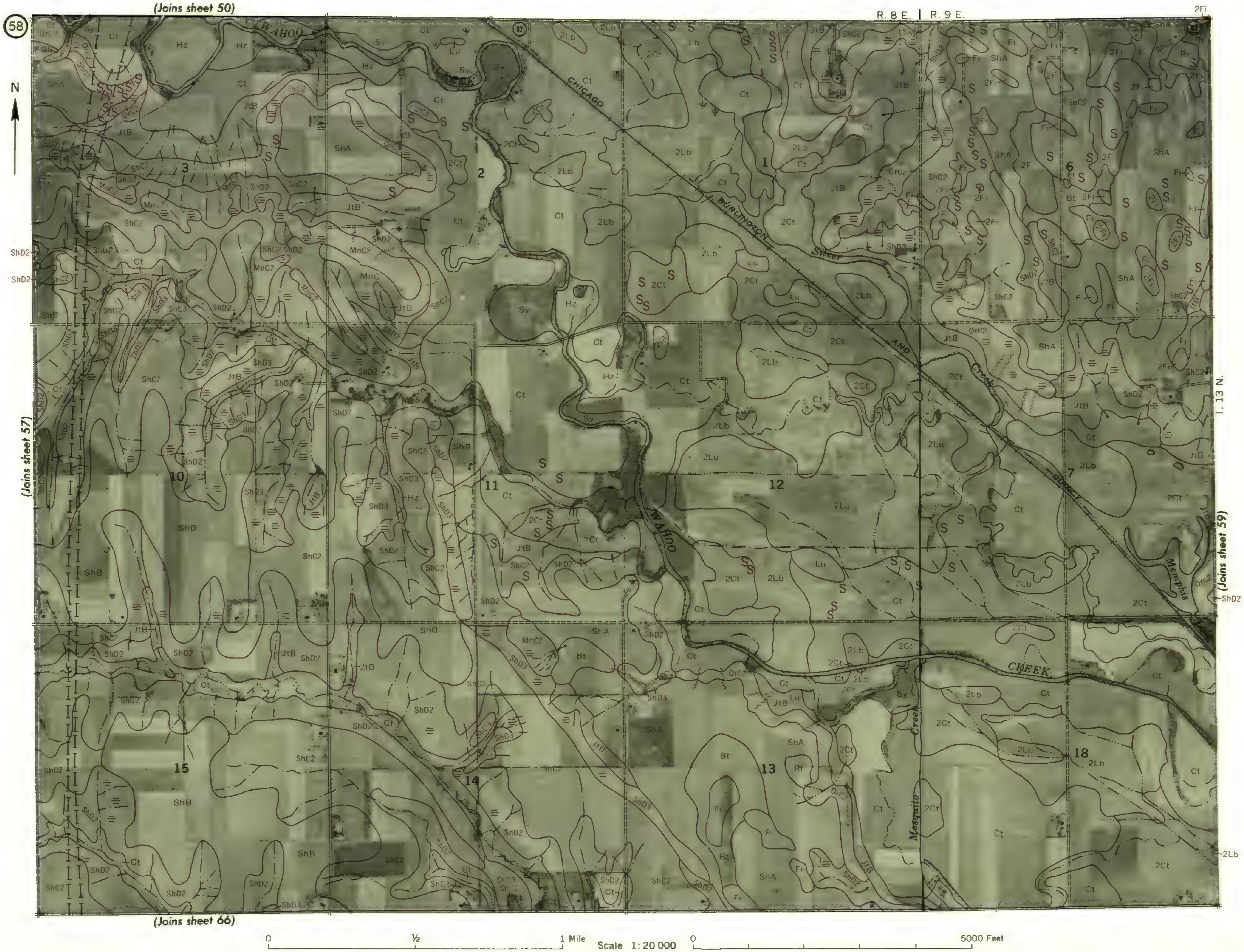
This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture and the Conservation and Survey Division, University of Nebraska.

Range, township, and section corners shown on this map are indefinite.


(Joins sheet 50)
(Joins sheet 57)
(Joins sheet 59)
(Joins sheet 66)
58
N
R. 8 E. | R. 9 E.
T. 13 N.
WAHOO CREEK
CHICAGO BURLINGTON AND QUINCY
Silver Creek
Memphis Creek
Mosquito Creek
0 ½ 1 Mile
Scale 1:20 000
0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska

Range, township, and section corners shown on this map are indefinite.

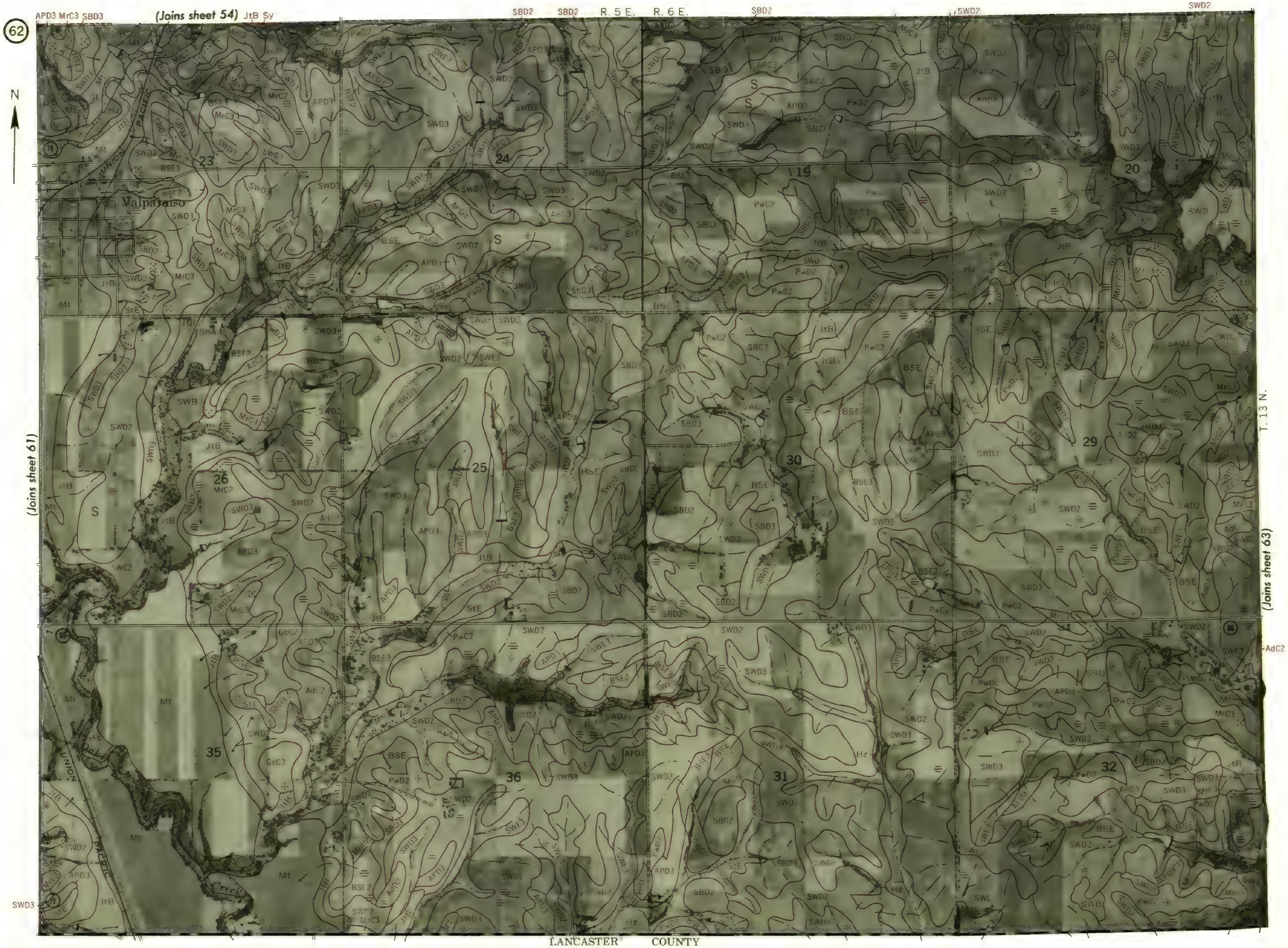
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska

Range, township, and section corners shown on this map are indefinite.

SAUNDERS COUNTY, NEBRASKA — SHEET NUMBER 62



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

SAUNDERS COUNTY, NEBRASKA — SHEET NUMBER 63

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

Range, township, and section corners shown on this map are indefinite.


64
(Joins sheet 56)
R. 7 E.
N
(Joins sheet 63)
(Joins sheet 65)
T. 13 N.
Hobsons
Ceresco
Rock
Creek
LANCASTER COUNTY
19
20
21
22
30
29
28
27
31
32
33
34
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

SAUNDERS COUNTY, NEBRASKA — SHEET NUMBER 66

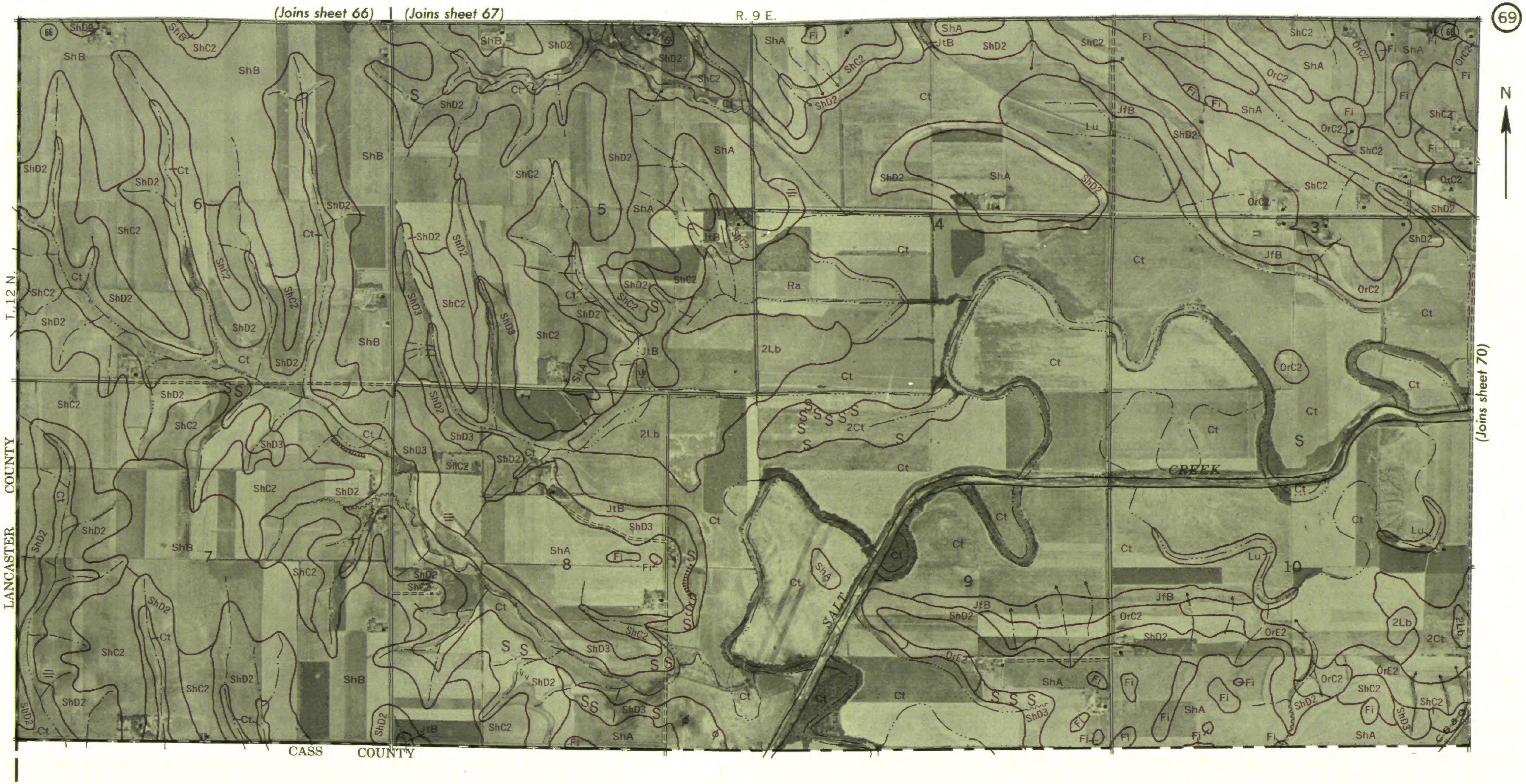
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

Range, township, and section corners shown on this map are indefinite.

SAUNDERS COUNTY, NEBRASKA — SHEET NUMBER 68

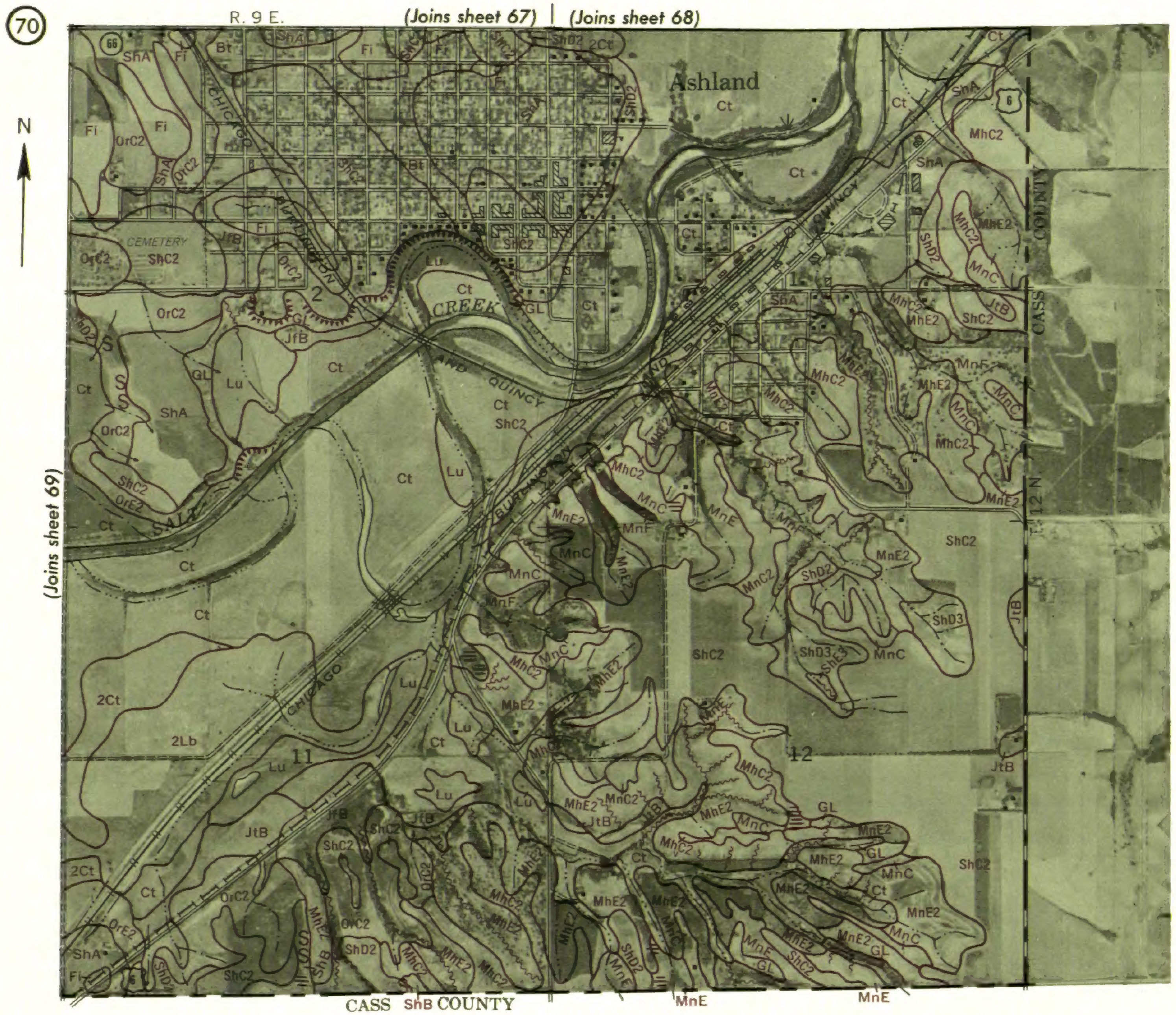
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Conservation and Survey Division, University of Nebraska.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet